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THE MAMMALS OF  
PAKISTAN







# THE MAMMALS OF PAKISTAN

T. J. ROBERTS

M.A.(CANTAB.), M.S.A.(BRIT. COL.)

WITH A FOREWORD BY HIS ROYAL HIGHNESS  
PRINCE BERNHARD OF THE NETHERLANDS



1977

ERNEST BENN LIMITED  
LONDON & TONBRIDGE

Published by Ernest Benn Limited  
25 New Street Square, London EC4A 3JA  
& Sovereign Way, Tonbridge, Kent TN9 1RW

First Edition 1977

© T. J. Roberts 1977

Printed in Great Britain

ISBN 0 510-39900-2



# FOREWORD

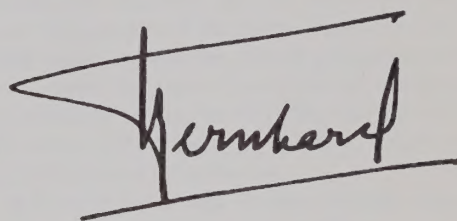
by His Royal Highness Prince Bernhard of the Netherlands

Throughout the ages Man always thought of the immensity of the planet on which he lived. There seemed endless space for expanding human occupation and activities. Indeed it seemed a challenge to man to move in and demonstrate his domination. Suddenly, in the past few years, the truth has been revealed to us — men have stood on the Moon and seen what a tiny island the Blue Planet Earth is. At the same time we have been witnessing the opening up to human exploitation of the last great wild natural areas in the desperate search for agricultural land, minerals and other products to support the exploding human population. We are faced with the fact that our resources are finite, and unless we conserve them the future of human existence is in doubt.

Of course we must all be interested in the survival of the human race. But we are not the only dwellers on Spaceship Earth. We are part of an intricate web involving thousands of forms of life, animal and plant, dependent to a greater or lesser degree on each other's existence, and on the physical

earth of soil and rock and water covered by a thin layer of air. Many forms of life have become extinct for natural reasons. Today over a thousand mammal and bird species and some 20,000 plants have been brought to the brink of oblivion by Man's activities.

The WWF and the IUCN are dedicated to meeting this challenge and to ensuring the survival of that rich variety of life which makes the world a rewarding place on which to live. One of the essential requirements is knowledge of the life of our fellow living species in all its wonderful and intricate varieties so that we can take the right action to see that they survive. Tom Roberts has already made a special contribution to this accumulation of knowledge, based on his studies over many years in Pakistan — studies in the highest traditions of the amateur naturalist, because at the same time he has been an active businessman. This book crowns his efforts. It will surely help to save Pakistan's wildlife by creating public awareness of the rich heritage which still exists.

A handwritten signature in dark ink, appearing to read 'Bernhard', is written over a horizontal line. The signature is stylized with a large, sweeping initial 'B'.





# PREFACE

In writing this book and preparing the illustrations, I have received help from many persons. Firstly, therefore, I wish to acknowledge the generous way in which many people, who have been locally resident in Pakistan, have shared their observations and knowledge of various regions. Foremost amongst these is Jerry Wood Anderson, naturalist and animal exporter. Many others are cited in the text but I would particularly mention Zahid Beg Mirza, Major S. Ammanullah Khan, Rohil F. Nana, Dr. Mirza Azhar Beg, Dr. Rehman Beg, Syed Asad Ali, Trevor Braham, Christopher Savage and Trevor Robertson, as well as my posthumous gratitude to the late Amir of Bahawalpur, to Lt. Gen. J. H. Marden, and to H. W. Waite and Kenneth Eates both formerly Deputy Inspectors General of Police. Secondly, I am much indebted to various international experts with specialized knowledge who have not only freely supplied information and advice based on their own observations but who have read and criticized various parts of the earlier drafts of this manuscript. First among these is Dr. George Schaller of the New York Zoological Society. I am also greatly indebted to Dr. Douglas Lay of Michigan University, Dr. Jochen Niethammer of Bonn University, Major Ian Grimwood of Nairobi, John Edwards Hill of the British Museum, Dr. George Pilleri of Berne, Dr. Daniel Walton of the World Health Organization and Mr. David Drummond of the British Ministry of Agriculture. All these persons unstintingly gave their time in reading the draft manuscript. Finally there are those who have helped with the more tedious and onerous tasks of editing, and retyping no less than three complete drafts of the manuscript. I particularly wish to thank my industrious wife, Frances, Mr. Wali Mohammed Sheikh and Mr. Kurshid Akbar.

I am much indebted for the courtesy and facilities extended to me by Mr J. E. Hill, who enabled me to study the collections in the British Museum (Natural History). Also Mr J. C. Daniel, the Curator of the Bombay Natural History Society's Museum and Dr. Henry W. Setzer, the Curator of Mammals in the Smithsonian Natural History Museum. Mr. Sifatullah Siddiqi the Director of the Zoological Survey of Pakistan kindly allowed me to borrow books from the excellent library

and also to examine the specimen collections. I also wish to acknowledge my debt to many correspondents who supplied helpful technical information, taxonomic comments and other criticisms. Among these I am especially grateful to Dr. Ivan Sokolov, Head of the Leningrad Academy of Science and several of his colleagues, also Dr. Richard Taber of Washington University and Dr. Robert Hoffman of Kansas University. Finally I am indebted to my friend Syed Babar Ali, International Trustee of the World Wildlife Fund who encouraged me in the first place to embark on this project.

The presentation of this book is intended to emphasize what is known about the biology and ecology of Pakistan's mammals. It is not intended as a detailed taxonomic treatment or review of the species described. Thus features observable in the field have been stressed rather than cranial or other taxonomic features. Wherever taxonomic comments seemed helpful, however, in highlighting additions to knowledge since previous published works about the mammals concerned, these have been included. So little is known about the present status or distribution of Pakistan's mammals that an attempt has been made to assess the overall position at the time of writing even where there is no first-hand knowledge or surveys obviously could not be carried out. This has been my major task, in fact, and no effort has been spared to collate and correlate reliable distributional information.

In conclusion, it is not from a sense of false modesty that I wish to acknowledge the shortcomings of this book. I am only an amateur naturalist without professional training in zoology, yet I would not have been content to present a purely descriptive or anecdotal account. But I feel that my work falls far short of the needs of a definitive scientific volume. Perhaps the shortcomings stem from the fact that in this age of specialization so much has been attempted by one person, including figure illustrations as well as the habitat photographs and writing. I ask the reader to judge this effort like those of the 'one-man bandsman' of old-time circuses and fairgrounds. It may not be real music but if it succeeds in catching the attention and stimulates an interest it will have fulfilled its intended purpose.





# CONTENTS

|   |             |
|---|-------------|
| <b>FOREWORD</b>   | <i>Page</i> |
| by His Royal Highness Prince Bernhard of the Netherlands  | v           |
| <b>PREFACE</b>  | vii         |
| <b>LIST OF SPECIES ILLUSTRATIONS</b>  | xxi         |
| <b>LIST OF FIGURES</b>  | xxii        |
| <b>LIST OF COLOUR PLATES</b>  | xxiv        |
| <b>LIST OF DISTRIBUTION MAPS</b>  | xxv         |
| <b>1 INTRODUCTION</b>   | 1           |
| Description of main geographic and zoological features of Pakistan.<br>Brief review of previous published accounts of mammalian fauna of the region.  |             |
| <b>2 ZOOGEOGRAPHICAL ASPECTS AND FAUNAL ORIGINS</b>   | 4           |
| Significance of major faunal regions, palearctic, oriental and ethiopian in relation to Pakistan. Effects of altitude on climate and hence mammalian fauna. Detailed description of 18 distinct ecological zones in Pakistan, with associated dominant plants and mammals. Brief discussion of the concept of ecological niche.   |             |
| <b>3 ECOLOGICAL ADAPTATION WITH SPECIAL REFERENCE TO DESERT SURVIVAL</b>  | 10          |
| The advantages of burrowing behaviour — significance of surface or skin area to volume ratio. Pelage adaptation of large mammals in Pakistan to cope with extremes of ambient temperature associated with steppic mountain conditions. Fat distribution and heat tolerance. Hibernation and aestivation with special reference to fauna of Baluchistan. Evaporative cooling and water replenishment adaptations. The problem of finding food in arid regions. Survival against predators and adaptation in desert-dwelling species for speed, agility, and camouflage. Adaptations for social interaction and reproduction. |             |
| <b>4 INSECTIVORA</b>  | 15          |
| Family ERINACEIDAE — Hedgehogs  | 15          |
| Key to Family ERINACEIDAE in Pakistan   | 15          |
| Key to Pakistan Genera of HEMIECHINUS and PARAECHINUS   | 15          |
| Genus HEMIECHINUS Fitzinger, 1866   | 15          |
| Key to Pakistan Species of <i>Hemiechinus</i>   | 15          |
| (i) Species <i>Hemiechinus auritus</i> Gmelin, 1770 — Long-eared Hedgehog   | 15          |
| (ii) Species <i>Hemiechinus megalotis</i> Blyth, 1845 — Afghan Hedgehog   | 18          |
| Genus PARAECHINUS Trouessart, 1879  | 20          |
| Key to Pakistan Species of <i>Paraechinus</i>   | 20          |
| (iii) Species <i>Paraechinus micropus</i> Blyth, 1846 — Pale or Indian Hedgehog   | 20          |
| (iv) Species <i>Paraechinus hypomelas</i> Brandt, 1836 — Brandt's Hedgehog  | 21          |
| Family SORICIDAE — Shrews   | 23          |
| Key to Family SORICIDAE in Pakistan   | 23          |
| Genus SOREX Linnaeus, 1758  | 23          |
| (v) Species <i>Sorex minutus</i> Linnaeus, 1766 — Lesser or Pygmy Shrew   | 23          |
| Genus SUNCUS Ehrenberg, 1833  | 25          |

|  |    |
|--|----|
| (vi) Species <i>Suncus murinus</i> Linnaeus, 1766 — House Shrew or Musk Shrew  | 25 |
| (vii) Species <i>Suncus etruscus</i> Savi, 1822 — Savi's Pygmy Shrew or Etruscan Shrew                               | 27 |
| (viii) Species <i>Suncus Stoliczkanus</i> Anderson, 1877 — Anderson's Shrew or Yellow-Throated Shrew                 | 28 |
| Genus CROCIDURA Wagler, 1832   | 29 |
| (ix) Species <i>Crocidura russula</i> Hermann, 1780 — Common White-Toothed Shrew                                     | 29 |
| (x) Species <i>Crocidura pergrisea</i> Miller, 1913 — Pale Grey Shrew  | 30 |
| (xi) Species <i>Crocidura attenuata</i> Milne-Edwards, 1872 — Grey Shrew   | 31 |
| <b>5 CHIROPTERA</b>  | 32 |
| Key to Sub-orders of CHIROPTERA  | 32 |
| Sub-order MEGACHIROPTERA — Fruit Eating Bats   | 32 |
| Key to Pakistan Genera of MEGACHIROPTERA   | 33 |
| Family PTEROPIDAE — Old World Fruit Bats, Flying Foxes   | 33 |
| Genus ROUSETTUS Gray, 1821   | 33 |
| Key to Pakistan Species of <i>Rousettus</i>  | 33 |
| (i) Species <i>Rousettus aegyptiacus arabicus</i> E. Geoffroy, 1810 — Egyptian Fruit Bat                             | 33 |
| Synonym <i>Rousettus arabicus</i>  | 33 |
| (ii) Species <i>Rousettus leschenaulti</i> Desmarest, 1820 — Fulvous Fruit Bat                                       | 36 |
| Genus PTEROPUS Brisson, 1762   | 38 |
| Key to Pakistan Species of <i>Pteropus</i>   | 38 |
| (iii) Species <i>Pteropus giganteus</i> Brünnich, 1782 — Indian Flying Fox   | 38 |
| Genus CYNOPTERUS F. Cuvier, 1824   | 40 |
| Key to Pakistan Species of <i>Cynopterus</i>   | 40 |
| (iv) Species <i>Cynopterus sphinx</i> Vahl, 1797 — Short-nosed Fruit Bat   | 40 |
| Sub-order MICROCHIROPTERA — Insectivorous Bats   | 41 |
| Key to Pakistan Genera of MICROCHIROPTERA  | 41 |
| Family RHINOPOMATIDAE — Mouse-tailed Bats  | 43 |
| Genus RHINOPOMA Geoffroy, 1818   | 43 |
| Key to Pakistan Species of <i>Rhinopoma</i>  | 43 |
| (v) Species <i>Rhinopoma microphyllum</i> Brünnich, 1782 — Larger Rat-tailed Bat or Mouse-tailed Bat                 | 43 |
| Synonym <i>Rhinopoma kinneari</i>  | 43 |
| (vi) Species <i>Rhinopoma hardwickei</i> Gray, 1831 — Lesser Rat-tailed Bat or Small Mouse-tailed Bat                | 44 |
| Family EMBALLONURIDAE — Sheath-tailed Bats, Sac-winged Bats  | 45 |
| Genus TAPHOZOUS Geoffroy, 1818   | 45 |
| Key to Pakistan Species of <i>Taphozous</i>  | 45 |
| Subgenus <i>Taphozous</i> Geoffroy, 1818   | 45 |
| (vii) Species <i>Taphozous perforatus</i> E. Geoffroy, 1818 — Tomb Bat or Egyptian Tomb Bat                          | 45 |
| Subgenus <i>Liponycteris</i> Thomas, 1922  | 47 |
| (viii) Species <i>Taphozous kachbensis</i> Dobson, 1872 — Kutch Sheath-tailed Bat or Naked-bellied Sheath-tailed Bat | 47 |
| Family MEGADERMATIDAE — False Vampires   | 49 |
| Genus MEGADERMA Geoffroy, 1810   | 49 |
| Subgenus <i>Lyroderma</i> Peters, 1872   | 49 |
| Key to Pakistan Species of <i>Megaderma</i>  | 49 |
| (ix) Species <i>Megaderma lyra</i> Geoffroy, 1810 — Indian False Vampire   | 49 |
| Family RHINOLOPHIDAE — Horseshoe Bats and Leaf-nosed Bats  | 52 |
| Subfamily RHINOLOPHINAE  | 52 |
| Genus RHINOLOPHUS Lacepède, 1799   | 52 |
| Key to Pakistan Species of <i>Rhinolophus</i>  | 52 |
| (x) Species <i>Rhinolophus ferrumequinum</i> Schreber, 1774 — Greater Horseshoe Bat                                  | 52 |
| (xi) Species <i>Rhinolophus hipposideros</i> Bechstein, 1800 — Lesser Horseshoe Bat                                  | 55 |



|   |    |
|---|----|
| (xii) Species <i>Rhinolophus blasili</i> Peters, 1866 — Blasius' or Peters' Horseshoe Bat                           | 55 |
| Subfamily HIPPOSIDERINAE — Leaf-nosed Bats  | 56 |
| Genus HIPPOSIDEROS Gray, 1831   | 56 |
| Key to Pakistan Species of <i>Hipposideros</i>  | 56 |
| (xiii) Species <i>Hipposideros fulvus</i> Gray, 1838  | 57 |
| Synonym <i>Hipposideros bicolor</i> Temminck, 1834 — Bicoloured Leaf-nosed Bat or Bicolour Roundleaf Horseshoe Bat  | 57 |
| Genus ASELLIA Gray, 1838  | 59 |
| Key to Pakistan Species of <i>Asellia</i>   | 59 |
| (xiv) Species <i>Asellia tridens</i> Geoffroy, 1813 — Trident Leaf-nosed Bat  | 59 |
| Family MOLOSSIDAE — Free-tailed Bats and Tomb Bats  | 60 |
| Key to Family MOLOSSIDAE in Pakistan  | 60 |
| Genus TADARIDA Rafinesque, 1814   | 60 |
| Key to Pakistan Species of <i>Tadarida</i>  | 60 |
| (xv) Species <i>Tadarida aegyptiaca</i> E. Geoffroy, 1818 — Egyptian Free-tailed Bat or Egyptian Wrinkle-lipped Bat | 61 |
| Synonym <i>Nyctinomus tragatus</i> Dobson, 1874   | 61 |
| Family VESPERTILIONIDAE — Vesper Bats, Noctules, Mouse-eared Bats, Pipistrelles, etc.                               | 63 |
| Genus MYOTIS Kaup, 1829   | 63 |
| Key to Pakistan Species of <i>Myotis</i>  | 63 |
| Subgenus <i>Selysius</i> Bonaparte, 1841  | 64 |
| (xvi) Species <i>Myotis mystacinus</i> Kuhl, 1819 — Whiskered Bat   | 64 |
| (xvii) Species <i>Myotis emarginatus</i> Geoffroy, 1806 — Geoffroy's Bat or Notch-eared Bat                         | 64 |
| Synonym <i>Myotis lancius</i> Oldfield Thomas, 1920   | 64 |
| Species <i>Myotis blythi</i> Tomes, 1857 — Lesser Mouse-eared Bat   | 65 |
| Species <i>Myotis longipes</i> Dobson, 1873 — Long-fingered Bat   | 65 |
| Genus EPTESICUS Rafinesque, 1820  | 65 |
| Key to Pakistan Species of <i>Eptesicus</i>   | 65 |
| (xviii) Species <i>Eptesicus nasutus</i> Dobson, 1877 — Sind Bat, Sind Serotine or Persian Serotine                 | 65 |
| Synonym <i>Vespertilio pellucens</i> Thomas, 1906   | 65 |
| (xix) Species <i>Eptesicus isabellinus</i> Temminck, 1840 — Isabelline Serotine                                     | 66 |
| Synonym <i>Eptesicus bottae ognevi</i> Bobrinskii, 1918   | 66 |
| (xx) Species <i>Eptesicus serotinus</i> Schreber, 1774 — Common Serotine  | 67 |
| Genus NYCTALUS Bowdich, 1825  | 67 |
| Key to Pakistan Species of <i>Nyctalus</i>  | 67 |
| (xxi) Species <i>Nyctalus leisleri</i> Kuhl, 1818 — Lesser Noctule or Hairy-armed Bat                               | 67 |
| (xxii) Species <i>Nyctalus noctula</i> Schreber, 1774 — Common Noctule  | 69 |
| Genus PIPISTRELLUS Kaup, 1829   | 69 |
| Key to Pakistan Species of <i>Pipistrellus</i>  | 70 |
| (xxiii) Species <i>Pipistrellus pipistrellus</i> Schreber, 1774 — Common Pipistrelle                                | 70 |
| (xxiv) Species <i>Pipistrellus coromandra</i> Gray, 1838 — Indian Pipistrelle                                       | 71 |
| (xxv) Species <i>Pipistrellus mimus</i> Wroughton, 1899 — Indian Pygmy Pipistrelle                                  | 71 |
| (xxvi) Species <i>Pipistrellus ceylonicus</i> Kelaart, 1852 — Kelaart's Pipistrelle                                 | 72 |
| (xxvii) Species <i>Pipistrellus kubli</i> Kuhl, 1819 — Kuhl's Pipistrelle   | 73 |
| (xxviii) Species <i>Pipistrellus babu</i> Thomas, 1915 — Himalayan Pipistrelle                                      | 74 |
| (xxix) Species <i>Pipistrellus dormeri</i> Dobson, 1875 — Dormer's Bat  | 74 |
| Synonym <i>Scotozous dormeri</i> Dobson, 1875   | 74 |
| Genus BARBASTELLA Gray, 1821  | 75 |
| Key to Pakistan Species of <i>Barbastella</i>   | 75 |
| (xxx) Species <i>Barbastella leucomelas</i> Cretzschmar, 1826 — Asian   |    |

|          |   |           |
|----------|---|-----------|
|          | Barbastelle or Asiatic Wide-eared Bat   | 75        |
|          | Synonym <i>Barbastella darjelingensis</i> Hodgson, 1855   | 75        |
|          | Genus NYCTICEIUS Rafinesque, 1819   | 76        |
|          | Key to Pakistan Species of <i>Nycticeius</i>  | 76        |
| (xxxix)  | Species <i>Nycticeius pallidus</i> Dobson, 1876 — Yellow Desert Bat   | 76        |
|          | Synonym <i>Scoteinus pallidus</i> Dobson, 1876  | 76        |
|          | Genus SCOTOPHILUS Leach, 1821   | 76        |
|          | Key to Pakistan Species of <i>Scotophilus</i>   | 77        |
| (xxxii)  | Species <i>Scotophilus kubli</i> Leach, 1821 — Temminck's House Bat or Lesser Yellow Bat                                | 77        |
|          | Synonym <i>Scotophilus temmincki</i> Horsfield, 1824  | 77        |
|          | Synonym <i>Scotophilus wroughtoni</i> Thomas, 1897  | 77        |
| (xxxiii) | Species <i>Scotophilus beathi</i> Horsfield, 1831 — Common Yellow-bellied Bat or Desert Scotophil or Greater Yellow Bat | 77        |
|          | Genus OTONYCTERIS Peters, 1859  | 79        |
|          | Key to Pakistan Species of <i>Otonycteris</i>   | 79        |
| (xxxiv)  | Species <i>Otonycteris hemprichi</i> Peters, 1859 — Hemprich's Long-eared Bat or Hemprich's Arrow-eared Bat             | 80        |
|          | Genus PLECOTUS Geoffroy, 1818   | 80        |
|          | Key to Pakistan Species of <i>Plecotus</i>  | 80        |
| (xxxv)   | Species <i>Plecotus austriacus</i> Fischer, 1829 — Grey Long-eared Bat  | 80        |
|          | Synonym <i>Plecotus puck</i> Barret-Hamilton, 1907  | 80        |
|          | Synonym <i>Plecotus wardi</i> Thomas, 1911  | 80        |
|          | Genus MINIOPTERUS Bonaparte, 1837   | 83        |
|          | Species <i>Miniopterus schreibersi</i> Kuhl, 1819 — Long-winged Bat or Schreiber's Bat                                  | 83        |
|          | Subfamily MURININAE — Tube-nosed Bats   | 83        |
|          | Genus MURINA Gray, 1842   | 83        |
|          | Key to Pakistan Species of <i>Murina</i>  | 83        |
| (xxxvi)  | Species <i>Murina buttoni</i> Peters, 1872 — Peters' Tube-nosed Bat   | 83        |
|          | Synonym <i>Harpiocephalus tubinarius</i> Scully, 1881   | 83        |
| <b>6</b> | <b>PRIMATES</b>   | <b>85</b> |
|          | Family CERCOPITHECIDAE — Baboons, Mangabeys, Guenons, Macaques, Rhesus Monkeys and Langurs                              | 85        |
|          | Key to Pakistan Species   | 85        |
|          | (i) Species <i>Macaca mulatta</i> Zimmermann, 1780 — Rhesus macaque   | 85        |
|          | (ii) Species <i>Presbytis entellus</i> Dufresne, 1797 — Grey Langur   | 88        |
| <b>7</b> | <b>PHOLIDOTA</b>  | <b>91</b> |
|          | Family MANIDAE — Scaly Anteaters  | 91        |
|          | Key to Pakistan Species   | 91        |
|          | Species <i>Manis crassicaudata</i> Gray, 1827 — Indian Pangolin or Scaly Anteater                                       | 91        |
| <b>8</b> | <b>CARNIVORA</b>  | <b>95</b> |
|          | Family CANIDAE — Wolves, Coyotes, Jackals, Foxes  | 95        |
|          | Key to Family CANIDAE in Pakistan   | 95        |
|          | Genus CANIS Linnaeus, 1758  | 95        |
|          | Key to Genus CANIS  | 95        |
|          | Key to Pakistan Species of <i>Canis</i>   | 95        |
|          | (i) Species <i>Canis lupus</i> Linnaeus, 1758 — Wolf  | 95        |
|          | (ii) Species <i>Canis aureus</i> Linnaeus, 1758 — Asiatic Jackal  | 98        |
|          | Genus VULPES Oken, 1816   | 100       |
|          | Key to Genus VULPES   | 100       |
|          | Key to Pakistan Species of <i>Vulpes</i>  | 100       |
|          | (iii) Species <i>Vulpes vulpes</i> Linnaeus, 1758 — Common Red Fox  | 100       |
|          | (iv) Species <i>Vulpes bengalensis</i> Shaw, 1800 — Indian or Bengal Fox  | 103       |
|          | (v) Species <i>Vulpes rüppelli</i> Schinz, 1825 — Rüppell's Fox or Sand Fox   | 104       |

|   |     |
|---|-----|
| (vi) Species <i>Vulpes cana</i> Blanford, 1877 — Blanford's Fox or King Fox                               | 105 |
| Genus CUON Hodgson, 1838  | 106 |
| Species <i>Cuon alpinus</i> Pallas, 1811 — Indian Wild Dog, Red Dog or Dhole                              | 106 |
| Family URSIDAE — Bears  | 106 |
| Key to Family URSIDAE   | 106 |
| Key to Pakistan Genera of URSIDAE   | 106 |
| Key to Pakistan Species of <i>Ursidae</i>   | 106 |
| Genus URSUS Linnaeus, 1758  | 107 |
| (vii) Species <i>Ursus arctos</i> Linnaeus, 1758 — Red Bear, Brown Bear or Snow Bear                      | 107 |
| Genus SELENARCTOS Heude, 1901   | 108 |
| (viii) Species <i>Selenarctos thibetanus</i> G. Cuvier, 1823 — Asiatic Black Bear or Himalayan Black Bear | 108 |
| Family MUSTELIDAE — Weasels, Martens, Badgers, Polecats, Skunks, Otters                                   | 111 |
| Key to Family MUSTELIDAE  | 111 |
| Subfamily MUSTELINAE — Martens  | 111 |
| Genus MARTES Pinel, 1792  | 111 |
| Key to Genus MARTES   | 111 |
| Key to Pakistan Species of <i>Martes</i>  | 111 |
| (ix) Species <i>Martes foina</i> Erxleben, 1777 — Beech Marten or Stone Marten                            | 111 |
| Subgenus CHARRONIA Gray, 1865   | 114 |
| (x) Species <i>Martes flavigula</i> Boddaert, 1785 — Yellow-throated Marten                               | 114 |
| Genus MUSTELA Linnaeus, 1758  | 116 |
| Key to Genus MUSTELA  | 116 |
| Key to Pakistan Species of <i>Mustela</i>   | 116 |
| (xi) Species <i>Mustela erminea</i> Linnaeus, 1758 — Stoat or Ermine                                      | 116 |
| (xii) Species <i>Mustela altaica</i> Pallas, 1811 — Alpine Weasel or Pale Weasel                          | 118 |
| Genus VORMELA Blasius, 1884   | 120 |
| Key to Pakistan Species of <i>Vormela</i>   | 120 |
| (xiii) Species <i>Vormela peregusna</i> Gldenstaedt, 1770 — Marbled Pole-cat                             | 120 |
| Subfamily MELLIVORINAE — Ratels   | 122 |
| Genus MELLIVORA Storr, 1780   | 122 |
| Key to Genus and Pakistan Species of <i>Mellivora</i>   | 122 |
| (xiv) Species <i>Mellivora capensis</i> Schreber, 1776 — Ratel or Honey Badger                            | 122 |
| Subfamily LUTRINAE — Otters   | 124 |
| Key to Subfamily LUTRINAE   | 124 |
| (xv) Species <i>Lutra lutra</i> Linnaeus, 1758 — Common Otter   | 124 |
| Subgenus LUTROGALE Gray, 1865   | 125 |
| Key to Subgenus and Pakistan Species of <i>Lutrogale</i>  | 125 |
| (xvi) Species <i>Lutra perspicillata</i> Geoffroy, 1826 — Smooth-coated Otter or Indian Otter             | 125 |
| Family VIVERRIDAE — Civet Cats, Genets, Mongooses, Palm Civets  | 127 |
| Key to Family VIVERRIDAE  | 127 |
| Subfamily VIVERRINAE — Civet Cats   | 127 |
| Genus VIVERRICULA Hodgson, 1838   | 127 |
| Key to Genus and Pakistan Species of <i>Viverricula</i>   | 127 |
| (xvii) Species <i>Viverricula indica</i> Desmarest, 1817 — Small Indian Civet or Rasse                    | 127 |
| Subfamily PARADOXURINAE   | 129 |
| Key to Subfamily PARADOXURINAE  | 129 |
| Genus PAGUMA Gray, 1831   | 129 |
| Key to Genus and Pakistan Species of <i>Paguma</i>  | 129 |
| (xviii) Species <i>Paguma larvata</i> Hamilton-Smith, 1827 — Masked Palm Civet                            | 129 |
| Subfamily HERPESTINAE — Mongooses   | 131 |
| Key to Subfamily HERPESTINAE  | 132 |
| Genus HERPESTES Illiger, 1811   | 132 |
| Key to Genus and Pakistan Species of <i>Herpestes</i>   | 132 |



|  |     |
|--|-----|
| (xix) Species <i>Herpestes auropunctatus</i> Hodgson, 1836 – Small Indian Mongoose or Gold Speckled Mongoose                           | 132 |
| Synonym <i>Herpestes javanicus</i> Pocock, 1937  | 132 |
| (xx) Species <i>Herpestes edwardsi</i> Geoffroy, 1818 – Indian Grey Mongoose or Common Indian Mongoose                                 | 133 |
| Family HYAENIDAE – Hyaenas   | 135 |
| Key to Family HYAENIDAE  | 135 |
| Genus HYAENA Brisson, 1762   | 135 |
| Key to Genus and Pakistan Species of <i>Hyaena</i>   | 135 |
| (xxi) Species <i>Hyaena hyaena</i> Linnaeus, 1758 – Striped Hyaena   | 135 |
| Family FELIDAE – Cats  | 137 |
| Key to Family FELIDAE  | 138 |
| Genus FELIS Linnaeus, 1758   | 138 |
| Key to Pakistan Species of <i>Felis</i>  | 138 |
| (xxii) Species <i>Felis libyca</i> Forster, 1780 – African Wild Cat  | 138 |
| Synonym <i>Felis constantina ornata</i> Gray, 1832   | 138 |
| (xxiii) Species <i>Felis chaus</i> Gldenstaedt, 1776 – Jungle Cat   | 140 |
| (xxiv) Species <i>Felis margarita</i> Loche, 1858 – Sand Cat or Dune Cat   | 142 |
| Synonym <i>Eremaelurus thinobius</i> Ognev, 1926   | 142 |
| Subgenus OCTOLOBUS Brandt, 1841  | 144 |
| (xxv) Species <i>Felis manul</i> Pallas, 1776 – Pallas' Cat or Steppe Cat  | 144 |
| Subgenus LYNX Kerr, 1792   | 145 |
| (xxvi) Species <i>Felis lynx</i> Linnaeus, 1758 – Lynx   | 145 |
| Subgenus CARACAL Gray, 1843  | 147 |
| (xxvii) Species <i>Felis caracal</i> Schreber, 1776 – Caracal or Red Lynx  | 147 |
| Subgenus PRIONAILURUS Severtzov, 1858  | 149 |
| (xxviii) Species <i>Felis bengalensis</i> Kerr, 1972 – Leopard Cat   | 149 |
| (xxix) Species <i>Felis viverrina</i> Bennett, 1833 – Fishing Cat  | 151 |
| Genus PANTHERA Oken, 1816  | 153 |
| Key to Subgenus PANTHERA   | 153 |
| Key to Pakistan Species of <i>Panthera</i>   | 153 |
| (xxx) Species <i>Panthera pardus</i> Linnaeus, 1758 – Panther or Leopard   | 153 |
| Subgenus TIGRIS Oken, 1816   | 155 |
| Species <i>Panthera tigris</i> Linnaeus, 1758 – Tiger (extinct in Pakistan)  | 155 |
| Subgenus LEO Oken, 1816  | 156 |
| Species <i>Panthera leo</i> Linnaeus, 1758 – Lion (extinct in Pakistan)  | 156 |
| Subgenus UNCIA Gray, 1854  | 156 |
| Key to Pakistan Species of <i>Uncia</i>  | 156 |
| (xxxi) Species <i>Panthera uncia</i> Schreber, 1776 – Snow Leopard or Ounce  | 156 |
| Genus ACINONYX Brookes, 1828   | 158 |
| Key to Pakistan Species of <i>Acinonyx</i>   | 158 |
| (xxxii) Species <i>Acinonyx jubatus</i> Schreber, 1776 – Cheetah   | 158 |
| <b>9 PERISSODACTYLA</b>  | 159 |
| Family RHINOCEROTIDAE – Rhinoceroses   | 159 |
| Key to Family RHINOCEROTIDAE   | 159 |
| Genus RHINOCEROS Linnaeus, 1758  | 159 |
| Species <i>Rhinoceros unicornis</i> Linnaeus, 1758 – Great One-horned Rhinoceros or Indian One-horned Rhinoceros (extinct in Pakistan) | 159 |
| Family EQUIDAE – Horses and Asses  | 159 |
| Key to Family EQUIDAE  | 159 |
| Genus EQUUS Linnaeus, 1758   | 159 |
| Key to Pakistan Species of <i>Equus</i>  | 159 |
| (i) Species <i>Equus hemionus</i> Pallas, 1775 – Asiatic Wild Ass  | 159 |
| <b>10 ARTIODACTYLA</b>   | 163 |
| Sub-order SUIFORMES  | 163 |
| Family SUIDAE – Pigs   | 163 |
| Genus SUS Linnaeus, 1758   | 163 |
| Key to Pakistan Species of <i>Sus</i>  | 163 |

|  |     |
|--|-----|
| (i) Species <i>Sus scrofa</i> Linnaeus, 1758 — Wild Pig or Indian Wild Boar                      | 163 |
| Sub-order RUMINANTIA   | 166 |
| Family CERVIDAE — Deer   | 166 |
| Key to Family CERVIDAE   | 167 |
| Subfamily MOSCHINAE — Musk Deer  | 167 |
| Genus MOSCHUS Linnaeus, 1758   | 167 |
| Key to Pakistan Species of <i>Moschus</i>  | 167 |
| (ii) Species <i>Moschus moschiferus</i> Linnaeus, 1758 — Musk Deer                               | 167 |
| Subfamily MUTIACINAE — Barking Deer  | 170 |
| Key to Subfamily MUNTIACINAE   | 170 |
| Genus MUNTIACUS Rafinesque, 1815   | 170 |
| Key to Pakistan Species of <i>Muntiacus</i>  | 170 |
| (iii) Species <i>Muntiacus muntjak</i> Zimmermann, 1780 — Indian Muntjac or Barking Deer         | 170 |
| Genus AXIS H. Smith, 1827  | 172 |
| Key to Pakistan Species of <i>Axis</i>   | 172 |
| (iv) Species <i>Axis porcinus</i> Zimmermann, 1780 — Hog Deer or Para                            | 172 |
| Genus CERVUS Linnaeus, 1758  | 174 |
| Key to Pakistan Species of <i>Cervus</i>   | 174 |
| Subgenus RUCERVUS Hodgson, 1838  | 175 |
| (v) Species <i>Cervus duvauceli</i> Cuvier, 1823 — Swamp Deer, Barasingha                        | 175 |
| (vi) Species <i>Cervus elaphus</i> Linnaeus, 1758 — Red Deer                                     | 175 |
| Family BOVIDAE   | 175 |
| Key to Family BOVIDAE  | 175 |
| Genus BOSELAPHUS Blainville, 1816  | 175 |
| Key to Pakistan Species of <i>Boselaphus</i>   | 175 |
| (vii) Species <i>Boselaphus tragocamelus</i> Pallas, 1766 — Nilgai or Blue Bull                  | 175 |
| Subfamily ANTILOPINAE  | 177 |
| Genus ANTILOPE Pallas, 1766  | 177 |
| Key to Pakistan Species of <i>Antilope</i>   | 177 |
| (viii) Species <i>Antilope cervicapra</i> Linnaeus, 1758 — Blackbuck                             | 178 |
| Genus GAZELLA Blainville, 1816   | 180 |
| Key to Genus GAZELLA Blainville, 1816  | 181 |
| Key to Pakistan Species of <i>Gazella</i>  | 181 |
| Subgenus TRACHELOCELE Ellerman and Morrison-Scott, 1951  | 181 |
| (ix) Species <i>Gazella subgutturosa</i> Gldenstaedt, 1780 — Goitred Gazelle or Persian Gazelle | 181 |
| (x) Species <i>Gazella gazella</i> Pallas, 1766 — Common or Indian Gazelle                       | 183 |
| Subfamily CAPRINAE   | 185 |
| Genus NAEMORHEDUS H. Smith, 1827   | 185 |
| Key to Pakistan Species of <i>Naemorhedus</i>  | 185 |
| (xi) Species <i>Naemorhedus goral</i> Hardwicke, 1825 — Grey Goral                               | 185 |
| Genus HEMITRAGUS Hodgson, 1841   | 188 |
| Species <i>Hemitragus jemlabicus</i> H. Smith, 1826 — Himalayan Tahr                             | 188 |
| Genus CAPRA Linnaeus, 1758   | 188 |
| Key to Genus CAPRA   | 188 |
| Key to Pakistan Species of <i>Capra</i>  | 188 |
| Subgenus CAPRA Linnaeus, 1758  | 189 |
| (xii) Species <i>Capra hircus</i> Linnaeus, 1758 — Wild Goat, Persian Pasang, Cretan Wild Goat   | 189 |
| Synonym <i>Capra aegagrus</i> Erxleben, 1777   | 189 |
| (xiii) Species <i>Capra ibex</i> Linnaeus, 1758 — Ibex   | 192 |
| Subgenus ORTHAEGOCEROS Trouessart, 1905  | 195 |
| (xiv) Species <i>Capra falconeri</i> Wagner, 1839 — Markhor                                      | 196 |
| (xv) Species <i>Capra falconeri chialtanensis</i> Lydekker, 1913 — Chiltan Markhor               | 200 |
| Genus PSEUDOIS Hodgson, 1846   | 200 |
| Key to Pakistan Species of <i>Pseudois</i>   | 200 |

|         |   |  |     |
|---------|---|--|-----|
| (xvi)   | Species <i>Pseudois nayaur</i>                | Hodgson, 1833 — Bharal or Blue Sheep                                     | 200 |
|         | Genus OVIS                                    | Linnaeus, 1758   | 203 |
|         | Key to Genus OVIS                             |  | 203 |
|         | Key to Pakistan Species of <i>Ovis</i>        |  | 203 |
| (xvii)  | Species <i>Ovis ammon</i>                     | Linnaeus, 1758 — Argali  | 203 |
| (xviii) | Species <i>Ovis orientalis</i>                | Gmelin, 1774 — Urial, Asiatic Mouflon or Shapu                           | 206 |
| 11      | <b>LAGOMORPHA</b>                             |  | 209 |
|         | Key to Order LAGOMORPHA                       |  | 209 |
|         | Family LEPORIDAE — Hares and Rabbits          |  | 209 |
|         | Key to Family LEPORIDAE                       |  | 209 |
|         | Genus LEPUS                                   | Linnaeus, 1758   | 209 |
|         | Key to Genus LEPUS                            |  | 209 |
|         | Key to Pakistan Species of <i>Lepus</i>       |  | 209 |
|         | (i) Species <i>Lepus nigricollis</i>          | Cuvier, 1832 — Indian Hare or Black-naped Hare                           | 210 |
|         | (ii) Species <i>Lepus capensis</i>            | Linnaeus, 1758 — Cape Hare   | 212 |
|         | (iii) Species <i>Lepus arabeus</i>            | Ehrenberg, 1833 — Arabian Hare   | 213 |
|         | Synonym <i>Lepus craspedotis</i>              | Blanford, 1875   | 213 |
|         | Family OCHOTONIDAE                            |  | 213 |
|         | Genus OCHOTONA                                | Link, 1795   | 213 |
|         | Key to Pakistan Species of <i>Ochotona</i>    |  | 213 |
|         | (iv) Species <i>Ochotona rufescens</i>        | Gray, 1842 — Afghan Pika or Collared Pika                                | 214 |
|         | (v) Species <i>Ochotona roylei</i>            | Ogilby, 1839 — Royle's Pika or Indian Pika                               | 216 |
|         | (vi) Species <i>Ochotona macrotis</i>         | Günther, 1875 — Large-eared Pika   | 217 |
| 12      | <b>RODENTIA</b>                               |  | 218 |
|         | Family SCIURIDAE — Squirrels, Chipmunks, etc. |  | 218 |
|         | Key to Family SCIURIDAE                       |  | 218 |
|         | Genus PETAURISTA                              | Link, 1795   | 218 |
|         | Key to Genus PETAURISTA                       |  | 218 |
|         | Key to Pakistan Species of <i>Petaurista</i>  |  | 218 |
|         | (i) Species <i>Petaurista petaurista</i>      | Pallas, 1766 — Giant Red Flying Squirrel or Indian Giant Flying Squirrel | 218 |
|         | Genus HYLOPETES                               | Thomas, 1908   | 223 |
|         | Key to Genus HYLOPETES                        |  | 223 |
|         | Key to Pakistan Species of <i>Hylopetes</i>   |  | 223 |
|         | (ii) Species <i>Hylopetes fimbriatus</i>      | Gray, 1837 — Small Kashmir Flying Squirrel                               | 223 |
|         | Genus EUPETAURUS                              | Thomas, 1888   | 225 |
|         | Key to Pakistan Species of <i>Eupetaurus</i>  |  | 225 |
|         | (iii) Species <i>Eupetaurus cinereus</i>      | Thomas, 1888 — Woolly Flying Squirrel                                    | 225 |
|         | Genus FUNAMBULUS                              | Lesson, 1835   | 226 |
|         | Key to Genus FUNAMBULUS                       |  | 226 |
|         | Key to Pakistan Species of <i>Funambulus</i>  |  | 226 |
|         | (iv) Species <i>Funambulus pennanti</i>       | Wroughton, 1905 — Northern Palm Squirrel or Five-striped Palm Squirrel   | 227 |
|         | Genus MARMOTA                                 | Blumenbach, 1779   | 228 |
|         | Key to Genus MARMOTA                          |  | 228 |
|         | Key to Pakistan Species of <i>Marmota</i>     |  | 228 |
|         | (v) Species <i>Marmota caudata</i>            | Jacquemont, 1844 — Long-tailed Marmot or Kashmir Marmot                  | 228 |
|         | Synonym <i>Marmota aureus</i>                 | Blanford, 1875   | 228 |
|         | Synonym <i>Marmota stirlingi</i>              | Thomas, 1916   | 228 |
|         | (vi) Species <i>Marmota bobak</i>             | Müller, 1776 — Himalayan or Bobak Marmot                                 | 232 |
|         | Family HYSTRICIDAE — Porcupines               |  | 233 |
|         | Key to Family HYSTRICIDAE                     |  | 233 |
|         | Genus HYSTRIX                                 | Linnaeus, 1758   | 233 |
|         | Key to Pakistan Species of <i>Hystrix</i>     |  | 233 |



|  |     |
|--|-----|
| (vii) Species <i>Hystrix indica</i> Kerr, 1792 — Indian Crested Porcupine  | 233 |
| Synonym <i>Hystrix leucura</i> Sykes, 1831   | 233 |
| Family DIPODIDAE — Birch Mice, Jerboas   | 236 |
| Key to Family DIPODIDAE  | 236 |
| Key to Pakistan Species in Family DIPODIDAE  | 236 |
| Subfamily SICISTINAE   | 236 |
| Key to Subfamily SICISTINAE  | 236 |
| Genus SICISTA Gray, 1827   | 236 |
| Key to Genus SICISTA   | 236 |
| Key to Pakistan Species of <i>Sicista</i>  | 236 |
| (viii) Species <i>Sicista concolor</i> Büchner, 1892 — Chinese Birch Mouse   | 236 |
| Synonym <i>Sminthus leathemi</i> Thomas, 1893  | 236 |
| Synonym <i>Sicista tianschanica</i> Salensky, 1903   | 236 |
| Subfamily CARDIOCRANIINAE — Dwarf or Pygmy Jerboas   | 238 |
| Key to Subfamily CARDIOCRANIINAE   | 238 |
| Genus SALPINGOTUS Vinogradov, 1922   | 238 |
| Key to Pakistan Species of <i>Salpingotus</i>  | 238 |
| (ix) Species <i>Salpingotus michaelis</i> Fitz Gibbon, 1966 — Pygmy Jerboa or Dwarf Three-toed Jerboa                                | 238 |
| Subfamily DIPODINAE  | 240 |
| Key to Subfamily DIPODINAE   | 240 |
| Genus ALLACTAGA Cuvier, 1836   | 240 |
| Key to Genus ALLACTAGA   | 240 |
| Key to Pakistan Species of <i>Allactaga</i>  | 242 |
| (x) Species <i>Allactaga elater</i> Lichtenstein, 1825 — Small Five-toed Jerboa  | 242 |
| (xi) Species <i>Allactaga hotsoni</i> Thomas, 1920 — Hotson's Five-toed Jerboa   | 244 |
| Species <i>Allactaga williamsi</i> Thomas, 1897 — Williams' Jerboa   | 245 |
| Synonym <i>Allactaga euphratica</i>  |     |
| Genus JACULUS Erxleben, 1777   | 245 |
| Key to Genus JACULUS   | 245 |
| Key to Pakistan Species of <i>Jaculus</i>  | 245 |
| (xii) Species <i>Jaculus blanfordi</i> Murray, 1884 — Blandford's Jerboa or Greater Three-toed Jerboa or Persian Brush-footed Jerboa | 245 |
| Family MUSCARDINIDAE — Dormice   | 247 |
| Key to Family MUSCARDINIDAE  | 248 |
| Subfamily MUSCARDININAE  | 248 |
| Genus DRYOMYS Thomas, 1906   | 248 |
| Key to Pakistan Species of <i>Dryomys</i>  | 248 |
| (xiii) Species <i>Dryomys nitedula</i> Pallas, 1779 — Forest Dormouse  | 248 |
| Family MURIDAE   | 250 |
| Key to Subfamily MURINAE   | 251 |
| Key to Subfamilies MURIDAE and CRICETIDAE  | 251 |
| Genus APODEMUS Kaup, 1829  | 252 |
| Key to Genus APODEMUS  | 252 |
| Key to Pakistan Species of <i>Apodemus</i>   | 252 |
| (xiv) Species <i>Apodemus sylvaticus</i> Linnaeus, 1758 — Wood Mouse or Field Mouse  | 252 |
| Species <i>Apodemus flavicollis</i> Melchior, 1834 — Yellow-necked Field Mouse   | 255 |
| Synonym <i>Apodemus griseus</i> True, 1894   | 255 |
| Subgenus MILLARDIA Thomas, 1911  | 255 |
| Key to Subgenus MILLARDIA  | 255 |
| Key to Pakistan Species of <i>Millardia</i>  | 255 |
| (xv) Species <i>Rattus meltada</i> Gray, 1837 — Soft-furred Field Rat or Metad   | 255 |
| Synonym <i>Millardia meltada pallidior</i> Ryley, 1914   | 255 |
| (xvi) Species <i>Rattus leadowi</i> Murray, 1885 — Sand-coloured Rat   | 257 |
| Synonym <i>Mus leadowi</i> Murray, 1885  | 257 |
| Synonym <i>Grypomys leadowi</i> Thomas, 1911   | 257 |
| Genus RATTUS Fischer, 1803   | 258 |

|   |     |
|---|-----|
| Key to Genus <i>RATTUS</i>  | 259 |
| Key to Pakistan Species of <i>Rattus</i>  | 259 |
| (xvii) Species <i>Rattus rattus</i> Linnaeus, 1758 — Roof Rat or Black Rat  | 259 |
| (xviii) Species <i>Rattus rattoides</i> Hodgson, 1845 — Turkestan Rat   | 260 |
| Synonym <i>Rattus turkestanicus</i> Satunin, 1903   | 260 |
| Species <i>Rattus nitidus</i> Hodgson, 1845 — Himalayan Rat   | 261 |
| (xix) Species <i>Rattus norvegicus</i> Berkenhout, 1769 — Norway, Brown or Sewer Rat                                      | 262 |
| Genus <i>MUS</i> Linnaeus, 1758   | 262 |
| Key to Genus <i>MUS</i>   | 262 |
| Key to Pakistan Species of <i>Mus</i>   | 262 |
| (xx) Species <i>Mus musculus</i> Linnaeus, 1758 — House Mouse   | 263 |
| (xxi) Species <i>Mus booduga</i> Gray, 1837 — Little Indian Field Mouse   | 264 |
| Synonym <i>Leggada booduga</i> Gray, 1837   | 264 |
| (xxii) Species <i>Mus cervicolor</i> Hodgson, 1845 — Fawn-coloured Mouse  | 265 |
| (xxiii) Species <i>Mus platythrix</i> Bennett, 1832 — Indian Brown Spiny Mouse  | 266 |
| Synonym <i>Leggada platythrix</i> Wroughton, 1911   | 266 |
| Genus <i>GOLUNDA</i> Gray, 1837   | 266 |
| Key to Genus and Pakistan Species of <i>Golunda</i>   | 266 |
| (xxiv) Species <i>Golunda ellioti</i> Gray, 1837 — Indian Bush Rat  | 267 |
| Genus <i>ACOMYS</i> Geoffroy, 1838  | 269 |
| Key to Genus and Pakistan Species of <i>Acomys</i>  | 269 |
| (xxv) Species <i>Acomys cabirinus</i> Desmarest, 1819 — Cairo Spiny Mouse   | 269 |
| Synonym <i>Acomys dimidiatus</i> Cretzschmar, 1826  | 269 |
| Genus <i>BANDICOTA</i> Gray, 1873   | 271 |
| Key to Genus <i>BANDICOTA</i>   | 271 |
| Key to Pakistan Species of <i>Bandicota</i>   | 271 |
| (xxvi) Species <i>Bandicota bengalensis</i> Gray and Hardwicke, 1833 — Lesser Bandicoot, Indian Mole Rat or Sind Rice Rat | 271 |
| Synonym <i>Nesokia bengalensis</i> Murray, 1884   | 271 |
| Synonym <i>Gunomys indicus</i> Wroughton, 1908  | 271 |
| Genus <i>NESOKIA</i> Gray, 1842   | 274 |
| Key to Genus and Pakistan Species of <i>Nesokia</i>   | 274 |
| (xxvii) Species <i>Nesokia indica</i> Gray and Hardwicke, 1832 — Short-tailed Mole Rat                                    | 274 |
| Synonym <i>Nesokia hardwickei</i> Gray, 1837  | 274 |
| Synonym <i>Nesokia huttoni</i> Blyth, 1846  | 274 |
| Key to Family CRICETIDAE — Hamsters, Gerbils and Jirds  | 276 |
| Genus <i>CALOMYSCUS</i> Thomas, 1905  | 276 |
| Key to Genus and Pakistan Species of <i>Calomyscus</i>  | 276 |
| (xxviii) Species <i>Calomyscus bailwardi</i> Thomas, 1905 — Mouse-like Hamster or Long-tailed Hamster                     | 277 |
| Genus <i>CRICETULUS</i> Milne-Edwards, 1867   | 279 |
| Key to Genus and Pakistan Species of <i>Cricetulus</i>  | 279 |
| (xxix) Species <i>Cricetulus migratorius</i> Pallas, 1773 — Migratory Hamster or Grey Hamster                             | 279 |
| Subfamily GERBILLINAE   | 281 |
| Key to Subfamily GERBILLINAE  | 281 |
| Genus <i>GERBILLUS</i> Desmarest, 1804  | 281 |
| Key to Genus <i>GERBILLUS</i>   | 281 |
| Key to Pakistan Species of <i>Gerbillus</i>   | 281 |
| (xxx) Species <i>Gerbillus nanus</i> Blanford, 1875 — Baluchistan Gerbil  | 281 |
| Synonym <i>Gerbillus nanus indus</i> Thomas, 1920   | 281 |
| (xxxii) Species <i>Gerbillus gleadowi</i> Murray, 1886 — Indian Hairy-footed Gerbil                                       | 283 |
| (xxxiii) Species <i>Gerbillus cheesmani</i> Thomas, 1919 — Cheesman's Gerbil  | 285 |
| Genus <i>TATERA</i> Lataste, 1882   | 285 |
| Key to Genus and Pakistan Species of <i>Tatera</i>  | 285 |
| (xxxiiii) Species <i>Tatera indica</i> Hardwicke, 1807 — Indian Gerbil or Antelope Rat                                    | 285 |

|   |     |
|---|-----|
| Genus MERIONES Illiger, 1811  | 288 |
| Key to Pakistan Species of <i>Meriones</i>  | 288 |
| (xxxiv) Species <i>Meriones persicus</i> Blanford, 1875 — Persian Jird                                | 288 |
| (xxxv) Species <i>Meriones hurrianae</i> Jerdon, 1867 — Indian Desert Jird or Indian Desert Gerbil    | 289 |
| (xxxvi) Species <i>Meriones libycus</i> Lichtenstein, 1823 — Libyan Jird                              | 291 |
| (xxxvii) Species <i>Meriones crassus</i> Sundevall, 1842 — Sundevall's Jird or Swinhoe's Jird         | 292 |
| Genus RHOMBOMYS Wagner, 1841  | 293 |
| Key to Genus and Pakistan Species of <i>Rhombomys</i>   | 293 |
| (xxxviii) Species <i>Rhombomys opimus</i> Lichtenstein, 1823 — Great Gerbil or Giant Day Jird         | 293 |
| Subfamily MICROTINAE — Voles and Lemmings   | 295 |
| Key to Subfamily MICROTINAE   | 295 |
| Genus ELLOBIUS Fischer, 1814  | 295 |
| Key to Genus and Pakistan Species of <i>Ellobius</i>  | 295 |
| (xxxix) Species <i>Ellobius fuscicapillus</i> Blyth, 1843 — Quetta Mole Vole or Afghan Mole Vole      | 296 |
| Genus ALTICOLA — Blanford, 1881   | 297 |
| Key to Genus ALTICOLA   | 297 |
| Key to Pakistan Species of <i>Alticola</i>  | 298 |
| (xl) Species <i>Alticola roylei</i> Gray, 1842 — Royle's High Mountain Vole                           | 298 |
| Species <i>Alticola stoliczkanus</i> Blanford, 1875 — Stoliczka's High Mountain Vole                  | 299 |
| Genus HYPERACRIUS Miller, 1896  | 300 |
| Key to Genus HYPERACRIUS  | 300 |
| Key to Pakistan Species of <i>Hyperacrius</i>   | 300 |
| (xli) Species <i>Hyperacrius wynnei</i> Blanford, 1881 — Murree Vole                                  | 300 |
| Synonym <i>Microtus wynnei</i> Miller, 1899   | 300 |
| (xlii) Species <i>Hyperacrius fertilis</i> True, 1894 — True's Vole or Burrowing Vole                 | 302 |
| Synonym <i>Microtus fertilis</i> Miller, 1896   | 302 |
| Genus PITYMYS McMurtie, 1831  | 304 |
| Key to Pakistan Species of <i>Pitymys</i>   | 304 |
| (xliii) Species <i>Pitymys carruthersi</i> Thomas, 1909 — Carruthers' Vole                            | 304 |
| <b>13 CETACEA</b>   | 306 |
| Key to Order CETACEA  | 306 |
| Key to Suborder MYSTICETI   | 306 |
| Key to Suborder ODONTOCETI  | 306 |
| Family BALAENOPTERIDAE — Baleen Whales  | 306 |
| Key to Family BALAENOPTERIDAE and Genus BALAENOPTERA  | 306 |
| Genus BALAENOPTERA Lacepède, 1804   | 306 |
| Key to species of <i>Balaenoptera</i> occurring in Pakistan Waters                                    | 306 |
| (i) Species <i>Balaenoptera physalus</i> Linnaeus, 1758 — Common Rorqual or Common Finback            | 306 |
| (ii) Species <i>Balaenoptera musculus</i> Linnaeus, 1758 — Great Blue Whale or Sulphur-bottomed Whale | 307 |
| Synonym <i>Sibbaldus musculus</i> Linnaeus, 1758  | 307 |
| Genus MEGAPTERA Gray, 1846  | 308 |
| Key to Genus and Species <i>Megaptera</i>   | 308 |
| Species <i>Megaptera novaeangliae</i> Borowski, 1781 — Humpback Whale                                 | 308 |
| Suborder ODONTOCETI   | 308 |
| Family PLATANISTIDAE — River Dolphins   | 308 |
| Subfamily PLATANISTINAE   | 308 |
| Key to Family PLATANISTIDAE and Genus PLATANISTA  | 308 |
| Genus PLATANISTA Wagler, 1830   | 308 |
| Key to Species of <i>Platanista</i> occurring in Pakistan Coastal Waters                              | 308 |
| (iii) Species <i>Platanista indi</i> Blyth, 1859 — Indus Dolphin                                      | 308 |
| Family PHYSETERIDAE — Sperm Whale, Pygmy Sperm Whale  | 312 |
| Key to Family PHYSETERIDAE  | 312 |
| Genus KOGIA Gray, 1846  | 312 |



|  |     |
|--|-----|
| Key to Species of <i>Kogia</i> occurring in Pakistan Waters  | 312 |
| (iv) Species <i>Kogia breviceps</i> Blainville, 1838 — Pygmy Sperm Whale   | 312 |
| Family PHOCAENIDAE — Porpoise, Finless Black Porpoise  | 313 |
| Genus NEOMERIS Gray, 1846  | 313 |
| Key to Species of <i>Neomeris</i> occurring in Pakistan Coastal Waters   | 313 |
| (v) Species <i>Neomeris phocaenoides</i> G. Cuvier, 1829 — Little Indian Porpoise or Black Finless Porpoise                | 313 |
| Family DELPHINIDAE — Dolphins  | 314 |
| Key to the Family DELPHINIDAE  | 314 |
| Genus DELPHINUS Linnaeus, 1758   | 314 |
| Key to Genus DELPHINUS   | 314 |
| Key to Pakistan Species of <i>Delphinus</i>  | 314 |
| (vi) Species <i>Delphinus capensis</i> Gray, 1828 — Cape Dolphin   | 315 |
| Genus SOTALIA (SOUSA) Gray, 1866   | 315 |
| Key to Genus and Pakistan Species of <i>Sousa</i>  | 315 |
| (vii) Species <i>Sousa plumbea</i> Gray, 1866 — Plumbeous Dolphin or Red Sea Dolphin                                       | 315 |
| Synonym <i>Sotalia plumbea</i> Cuvier, 1829  | 315 |
| Genus TURSIOPS Gervais, 1855   | 316 |
| Key to Genus TURSIOPS  | 316 |
| Key to Species of <i>Tursiops</i> occurring in Pakistan Coastal Waters   | 316 |
| (viii) Species <i>Tursiops aduncus</i> Ehrenberg, 1833 — Red Sea Bottle-nosed Dolphin or Eastern Bottle-nosed Dolphin      | 316 |
| Genus LAGENORHYNCHUS Gray, 1846  | 317 |
| Key to the Genus LAGENORHYNCHUS  | 317 |
| Key to Species of <i>Lagenorhynchus</i> occurring in Pakistan Coastal Waters   | 318 |
| (ix) Species <i>Lagenorhynchus electra</i> Gray, 1846 — Indian Broad-beaked Dolphin or Electra Dolphin                     | 318 |
| Synonym <i>Peponocephala electra</i> Nishiwaki & Norris, 1965  | 318 |
| <b>APPENDIX 1 TECHNIQUES OF STUDYING MAMMALS IN PAKISTAN</b>   | 319 |
| Methods of trapping specimens. Recording information from dead specimens. Study of captive mammals and field observations. |     |
| <b>APPENDIX 2 BIBLIOGRAPHY</b>   | 325 |
| <b>APPENDIX 3 GAZETTEER OF PAKISTAN</b>  | 336 |
| <b>APPENDIX 4 GLOSSARY OF VERNACULAR TERMS</b>   | 345 |
| <b>APPENDIX 5 GLOSSARY OF TECHNICAL TERMS</b>  | 346 |
| <b>INDEX</b>   | 349 |

# LIST OF SPECIES ILLUSTRATIONS

| Number |   | Page | Number |  | Page |
|--------|---|------|--------|--|------|
| 1      | <i>Hemiechinus auritus</i> : Long-eared or Collared Hedgehog.                             | 16   | 48     | <i>Sus scrofa</i> : Wild Pig or Indian Wild Boar.                            | 163  |
| 2      | <i>Hemiechinus megalotis</i> : Afghan Hedgehog.   | 19   | 49     | <i>Moschus moschiferus</i> : Musk Deer.                                      | 168  |
| 3      | <i>Paraechinus micropus</i> : Pale Hedgehog.  | 20   | 50     | <i>Muntiacus muntjak</i> : Muntjac or Barking Deer.                          | 170  |
| 4      | <i>Suncus murinus</i> : Indian Musk Shrew or House Shrew.                                 | 26   | 51     | <i>Axis porcinus</i> : Hog Deer or Para.                                     | 173  |
| 5      | <i>Crociodura russula</i> : Common White-toothed Shrew.                                   | 29   | 52     | <i>Boselaphus tragocamelus</i> : Nilgai or Blue Bull.                        | 176  |
| 6      | <i>Rousettus leschenaulti</i> : Fulvous Fruit Bat.  | 36   | 53     | <i>Antilope cervicapra</i> : Blackbuck.                                      | 178  |
| 7      | <i>Pteropus giganteus</i> : Flying Fox.   | 39   | 54     | <i>Gazella gazella</i> : Chinkara or Indian Gazelle.                         | 184  |
| 8      | <i>Rhinopoma microphyllum</i> : Greater Mouse-tailed Bat.                                 | 42   | 55     | <i>Naemorhedus goral</i> : Grey Goral.                                       | 187  |
| 9      | <i>Taphozous nudiventris kachhensis</i> : Naked-bellied Sheath-tailed Bat.                | 47   | 56     | <i>Capra hircus</i> : Persian Wild Goat or Sind Ibex.                        | 189  |
| 10     | <i>Megaderma lyra</i> : Indian False Vampire.   | 49   | 57     | <i>Capra ibex sibirica</i> : Himalayan Ibex.                                 | 192  |
| 11     | <i>Rhinolophus blasii</i> : Peters' or Blasius' Horseshoe Bat.                            | 56   | 58     | <i>Capra falconeri falconeri</i> : Astor Markhor.                            | 196  |
| 12     | <i>Tadarida aegyptiaca</i> : Egyptian Wrinkle-lipped or Free-tailed Bat.                  | 61   | 59     | <i>Pseudois nayaaur</i> : Bharal or Blue Sheep.                              | 201  |
| 13     | <i>Pipistrellus ceylonicus</i> : Kelaart's Pipistrelle.                                   | 73   | 60     | <i>Ovis ammon polii</i> : Marco Polo's Sheep.                                | 204  |
| 14     | <i>Scotophilus heatbi</i> : Yellow-bellied Bat or Desert Scotophil or Greater Yellow Bat. | 78   | 61     | <i>Ovis orientalis</i> : Urial or Shapu.                                     | 206  |
| 15     | <i>Plecotus austriacus</i> : Grey Long-eared Bat.   | 81   | 62     | <i>Lepus capensis</i> : Baluchistan or Cape Hare.                            | 212  |
| 16     | <i>Macaca mulatta</i> : Himalayan Rhesus Monkey.  | 85   | 63     | <i>Ochotona rufescens</i> : Afghan Pika or Collared Pika.                    | 214  |
| 17     | <i>Presbytis entellus</i> : Kashmir Grey Langur.  | 88   | 64     | <i>Petaurista petaurista</i> : Giant Red Flying Squirrel.                    | 220  |
| 18     | <i>Manis crassicaudata</i> : Indian Pangolin or Scaly Anteater.                           | 92   | 65     | <i>Hylopetes fimbriatus</i> : Small Kashmir Flying Squirrel.                 | 224  |
| 19     | <i>Canis lupus pallipes</i> : Indian Wolf.  | 96   | 66     | <i>Funambulus pennanti</i> : Five Striped Palm Squirrel.                     | 227  |
| 20     | <i>Canis aureus</i> : Asiatic Jackal.   | 98   | 67     | <i>Marmota caudata</i> : Long-tailed Marmot.                                 | 229  |
| 21     | <i>Vulpes vulpes griffithi</i> : Kashmir or Hill Fox.                                     | 102  | 68     | <i>Hystrix indica</i> : Indian Crested Porcupine.                            | 233  |
| 22     | <i>Vulpes bengalensis</i> : Bengal Fox or Indian Fox.                                     | 104  | 69     | <i>Sicista concolor</i> : Chinese Birch Mouse.                               | 237  |
| 23     | <i>Ursus arctos</i> : Brown Bear or Snow Bear.  | 107  | 70     | <i>Salpingotus michaelis</i> : FitzGibbon's Pygmy Jerboa.                    | 239  |
| 24     | <i>Selenarctos thibetanus</i> : Asiatic or Himalayan Black Bear.                          | 109  | 71     | <i>Allactaga elater</i> : Small Five-toed Jerboa.                            | 242  |
| 25     | <i>Martes foina</i> : Beech Marten or Stone Marten.                                       | 112  | 72     | <i>Jaculus blanfordi</i> : Blandford's or Persian Lesser Jerboa.             | 246  |
| 26     | <i>Martes flavigula</i> : Yellow-throated Marten.   | 114  | 73     | <i>Dryomys nitedula</i> : Forest Dormouse.                                   | 248  |
| 27     | <i>Mustela erminea</i> : Stoat or Ermine.   | 117  | 74     | <i>Apodemus sylvaticus</i> : Common Field Mouse.                             | 253  |
| 28     | <i>Mustela altaica</i> : Alpine Weasel or Altai Weasel.                                   | 119  | 75     | <i>Rattus meltada</i> : Soft-furred Field Rat or Metad.                      | 256  |
| 29     | <i>Vormela peregusna</i> : Marbled Pole-cat or Sarman-tier.                               | 121  | 76     | <i>Rattus turkestanicus</i> : Turkestan Rat.                                 | 261  |
| 30     | <i>Mellivora capensis</i> : Ratel or Honey Badger.  | 123  | 77     | <i>Mus booduga</i> : Little Indian Field Mouse.                              | 264  |
| 31     | <i>Lutra perspicillata</i> : Smooth-coated Indian Otter.                                  | 126  | 78     | <i>Golunda ellioti</i> : Bush Rat.   | 267  |
| 32     | <i>Viverricula indica</i> : Small Indian Civet or Rasse.                                  | 128  | 79     | <i>Acomys cahirinus</i> : Cairo Spiny Mouse.                                 | 270  |
| 33     | <i>Paguma larvata</i> : Masked Palm Civet or Himalayan Palm Civet.                        | 130  | 80     | <i>Bandicota bengalensis</i> : Lesser Bandicoot Rat or Indian Mole Rat.      | 272  |
| 34     | <i>Herpestes auropunctatus</i> : Small Indian Mongoose or Gold Speckled Mongoose.         | 132  | 81     | <i>Nesokia indica</i> : Short-tailed Bandicoot Rat or Short-tailed Mole Rat. | 275  |
| 35     | <i>Herpestes edwardsi</i> : Indian Grey Mongoose.   | 134  | 82     | <i>Calomyscus bailwardi</i> : Mouse-like Hamster.                            | 277  |
| 36     | <i>Hyaena hyaena</i> : Striped Hyaena.  | 136  | 83     | <i>Cricetulus migratorius</i> : Migratory Hamster.                           | 279  |
| 37     | <i>Felis libyca</i> : Desert Cat.   | 139  | 84     | <i>Gerbillus gleadowi</i> : Hairy-footed Gerbil.                             | 284  |
| 38     | <i>Felis chaus</i> : Jungle Cat.  | 140  | 85     | <i>Tatera indica</i> : Indian Gerbil or Antelope Rat.                        | 286  |
| 39     | <i>Felis margarita</i> : Sand Cat or Dune Cat.  | 142  | 86     | <i>Meriones hurrianæ</i> : Indian Desert Jird.                               | 290  |
| 40     | <i>Felis manul</i> : Pallas' Cat.   | 144  | 87     | <i>Rhombomys opimus</i> : Giant Day Jird or Great Gerbil.                    | 294  |
| 41     | <i>Felis lynx isabellina</i> : Himalayan Lynx.  | 146  | 88     | <i>Ellobius fuscocapillus</i> : Quetta Mole-Vole or Afghan Mole-Vole.        | 297  |
| 42     | <i>Felis caracal</i> : Caracal.   | 148  | 89     | <i>Alticola roylei</i> : Royle's High Mountain Vole.                         | 298  |
| 43     | <i>Felis bengalensis</i> : Leopard Cat.   | 149  | 90     | <i>Hyperacrius wynnei</i> : Murree Vole.                                     | 301  |
| 44     | <i>Felis viverrina</i> : Fishing Cat.   | 151  | 91     | <i>Platanista indi</i> : Indus Dolphin.                                      | 309  |
| 45     | <i>Panthera pardus</i> : Leopard or Panther.  | 154  | 92     | <i>Kogia breviceps</i> : Pygmy Sperm Whale.                                  | 312  |
| 46     | <i>Panthera uncia</i> : Snow Leopard.   | 156  | 93     | <i>Neomeris phocaenoides</i> : Finless Black Porpoise.                       | 313  |
| 47     | <i>Equus hemionus</i> : Asiatic Wild Ass or Onager.                                       | 160  | 94     | <i>Sousa plumbea</i> : Plumbeous Dolphin.                                    | 316  |
|        |   |      | 95     | A. <i>Tursiops aduncus</i> : Red Sea or Pacific Bottle-nosed Dolphin.        |      |
|        |   |      |        | B. <i>Lagenorhynchus electra</i> : Indian Broad-beaked or Electra Dolphin.   | 317  |

# LIST OF FIGURES

| Number | Page   | Number | Page |   |     |
|--------|--|--------|------|---|-----|
| 1      | Map of Pakistan showing provincial and former native state boundaries and important towns.   | 2      | 31   | Showing lateral view of skulls of monkey species.   | 86  |
| 2      | Map of Pakistan showing main rivers, hills and mountain ranges   | 5      | 32   | Showing detail of body scales of <i>Manis crassicaudata</i> .   | 91  |
| 3      | Map of Pakistan showing nine major ecological or vegetative zones. See Plates' section.  | 7      | 33   | Showing skull of female <i>Manis crassicaudata</i> .  | 92  |
| 4      | Map of Pakistan showing main rivers, major sand-dune desert tracts with proposed or existing wild life sanctuaries and national parks.         | 15     | 34   | Showing dorsal view of skulls of <i>Carnivora</i> .   | 96  |
| 5      | Showing difference in arrangement of spines on fore-crown of hedgehogs of genera <i>Paraechinus</i> and <i>Hemiechinus</i> .                   | 16     | 35   | Showing heads of Pakistan fox species.  | 101 |
| 6      | Showing difference in characteristic spinal pattern of Pakistan hedgehog species.  | 21     | 36   | Showing tails of Pakistan fox species.  | 101 |
| 7      | Showing variation in face mask pattern of <i>Paraechinus Paraechinus micropus</i> . These six specimens were all collected from southern Sind. | 22     | 37   | Showing lateral view of skulls of bears.  | 106 |
| 8      | Showing lateral view of hedgehog and shrew skulls.   | 24     | 38   | Showing soles of feet of <i>Selenarctos thibetanus gedrosianus</i> .  | 109 |
| 9      | Showing differences between mice ( <i>Muridae</i> ) and shrews ( <i>Soricidae</i> ).   | 25     | 39   | Showing soles of feet and other details of <i>Martes</i> species.   | 113 |
| 10     | Showing upper tooth row of shrew species.  | 32     | 40   | Showing front view of skulls of <i>Mustela</i> species.   | 116 |
| 11     | Showing right wing of bat species with method of measuring forearm length.   | 33     | 41   | Dorsal view of skulls of three different families of <i>Carnivora</i> .   | 117 |
| 12     | Showing diagrammatic ventral view of a bat, illustrating main anatomical features of importance in differentiating between species.            | 35     | 42   | Showing means of identification of otter species in Pakistan.   | 124 |
| 13     | Showing variations in the shapes of the interfemoral membrane as well as the tail in different families of bats.                               | 36     | 43   | Showing details of arboreal Palm Civet and fossorial Mongoose.  | 131 |
| 14     | Showing lateral view of skulls of various Chiropteran species.   | 46     | 44   | Lateral view of skulls showing difference between Snow Leopard and Panther.   | 153 |
| 15     | Showing ventral view female <i>Rousettus leschenaulti</i> carrying young in characteristic position.   | 49     | 45   | Showing lateral view of skull of adult male <i>Equus hemionus</i> .   | 159 |
| 16     | Showing distinctive features of <i>Taphozous</i> species in Pakistan.  | 50     | 46   | Showing sole of right fore-foot of <i>Equus hemionus</i> .  | 160 |
| 17     | Showing front view of head of <i>Megaderma lyra</i> .  | 53     | 47   | Showing difference between dentition of lower jaw of <i>Suidae</i> and <i>Bovidae</i> .   | 164 |
| 18     | Showing methods of folding wingtips when at rest, which are characteristic of certain bat genera.  | 54     | 48   | Showing lateral view of skull of <i>Moschus moschiferus</i> .   | 167 |
| 19     | Showing dorsal view interfemoral membrane of certain Microchiropteran genera.  | 57     | 49   | Showing features of Musk Deer.  | 168 |
| 20     | Showing characteristic features of Horseshoe bats.   | 59     | 50   | Showing skull of <i>Muntiacus muntjak</i> , adult male.   | 171 |
| 21     | Showing characteristic features of <i>Hipposideros</i> bats.   | 61     | 51   | Showing typical difference between heads of adult male Chinkara and Goitred Gazelle.  | 180 |
| 22     | Showing head of <i>Asellia tridens</i> with characteristic appearance of noseleaf.   | 63     | 52   | Showing features of Gazelle species and comparison with wild goat.  | 181 |
| 23     | Showing distinctive features of <i>Tadarida</i> genus.   | 66     | 53   | Showing distinction between heads of adult Himalayan Grey Goral.  | 186 |
| 24     | Showing upper right side maxillary tooth row of various Vespertilionid Bat species.  | 68     | 54   | Showing difference between bony core of horns of wild goat species in Pakistan.   | 188 |
| 25     | Showing side view of heads of: 1. <i>Eptesicus nasutus</i> ; 2. <i>Nycticeius pallidus</i> .   | 79     | 55   | Showing typical heads of mature male Markhor representing six major subspecies.   | 195 |
| 26     | Showing skulls of various <i>Microchiroptera</i> .   | 81     | 56   | Showing difference in appearance of Bharal rams' horns according to age.  | 202 |
| 27     | Showing differences between various bats' ears.  | 82     | 57   | Showing lateral view of skulls of <i>Lagomorphs</i> .   | 209 |
| 28     | Showing difference between <i>os penis</i> of <i>Plecotus auritus</i> and <i>Plecotus austriacus</i> .   | 83     | 58   | Showing features of Pikas.  | 215 |
| 29     | Showing typical roosting posture of <i>Plecotus austriacus</i> .   | 83     | 59   | Showing difference between skulls of <i>Petaurista</i> and <i>Hylopetes</i> genera of Flying Squirrels.                         | 219 |
| 30     | Showing characteristic appearance of Tube-nosed bats.  | 83     | 60   | Showing distinction between hind-foot of Flying Squirrel species in Pakistan, and other features.                               | 221 |
|        |  |        | 61   | Showing distinction between <i>Petaurista</i> and <i>Hylopetes</i> genera, and field signs of Flying Squirrel feeding activity. | 222 |
|        |  |        | 62   | Showing skulls of <i>Sciuridae</i> .  | 229 |
|        |  |        | 63   | Showing foot of <i>Marmota caudata</i> .  | 230 |
|        |  |        | 64   | Showing features of <i>Hystrix indica</i> .   | 234 |
|        |  |        | 65   | Showing ventral view of skulls of: A. <i>Jaculus blanfordi</i> ; B. <i>Allactaga elater</i> .                                   | 241 |
|        |  |        | 66   | Showing different appearances of Jerboa species.  | 241 |
|        |  |        | 67   | Lateral view of rodent skulls representing  |     |



## xxiii

| Number | Page  | Number | Page   |
|--------|---|--------|--|
|        | <i>Dipodidae</i> and <i>Microtinae</i> . 243  |        | <i>penis</i> of <i>Hyperacrius</i> (Vole) species. 303   |
| 68     | Showing difference between cheek teeth of <i>Muridae</i> and <i>Cricetidae</i> . 250  | 79     | Showing difference between bony palate of <i>Alticola</i> and <i>Pitymys</i> voles and comparison of first lower molars. 304 |
| 69     | Showing useful field characters for identifying rodent genera. 254  | 80     | Showing skull of <i>Balaenoptera physalus</i> . 307  |
| 70     | Showing comparison of rodents' ears and feet. 268   | 81     | Showing comparison between typical silhouettes of Dolphin species. 311   |
| 71     | Showing features of Bush Rat. 268   | 82     | Showing lateral view of skull of <i>Platanista indi</i> . 311  |
| 72     | Showing ventral view of skulls of: A. <i>Bandicota bengalensis</i> ; B. <i>Nesokia indica</i> ; C. lateral view skull and mandible of <i>Nesokia indica</i> . 272 | 83     | Showing heads of whales. 312   |
| 73     | Showing ventral view of skulls of: A. <i>Cricetulus migratorius</i> ; B. <i>Calomyscus bairdardi</i> . 278  | 84     | Showing dorsal view of skull of <i>Neomeris phocaenoides</i> . 313   |
| 74     | Showing appearance of <i>Cricetulus migratorius</i> from the front when its cheek pouches are stuffed full of food. 280   | 85     | Showing design of cage trap suitable for catching live rodents or shrews. 319  |
| 75     | Showing ventral view of rodents' fore and hind feet. 284  | 86     | Showing trap suitable for killing small burrowing or fossorial mammals. 320  |
| 76     | Showing skull of <i>Ellobius fuscicapillus</i> . 295  | 87     | Showing suitable cage trap for live trapping small carnivores. 320   |
| 77     | Showing comparison between upper right side (maxillary) tooth row of a rat and certain voles. 300   | 88     | Showing methods of taking standard body measurements of small mammals. 321   |
| 78     | Showing difference between the baculum (os  | 89     | Showing typical appearance of faecal pellets. 323  |
|        |   | 90     | Showing typical appearance of foot tracks. 323   |

# LIST OF COLOUR PLATES

The Plates section is to be found between pages 6 and 7.

## 1 Aspects of five major ecological zones at lower altitudes.

- (a) Intertidal zone showing mangroves (*Avicennia officinalis*) at high tide in Indus mouth.
- (b) Riverain and monsoon seasonal inundation zone, showing *Saccharum* grasses and *Prosopis* thorn scrub, 400ft elevation.
- (c) Arid subtropical zone showing *Nannorrhops ritchieana* palm, Kirthar hills, 1000ft elevation.
- (d) Tropical thorn forest in Salt Range with *Olea cuspidata* and *Acacia modesta*, 2500ft elevation.
- (e) Baluchistan desert, stony peneplain near Dalbandin, 2500ft elevation.
- (f) Baluchistan desert. Soft sand-dunes near Nushki, 3200ft elevation.

## 2 Aspects of five major ecological zones at intermediate elevations.

- (a) Baluchistan desert scrub at 6000ft elevation. *Sophora griffithii* bush in foreground.
- (b) Mountain steppe forest in southern latitudes. *Juniperus macropoda* trees with *Berberis baluchistani*, 8500ft elevation.
- (c) Tropical dry deciduous scrub forest. Margala hills, 3000ft elevation with *Baobab* and *Cassia* species and *Zizyphus mauritiana* undershrub.

- (d) Subtropical pine forest interspersed with cultivation and orchards. *Pinus roxburghii* in background, 5000ft elevation.

- (e) Himalayan moist temperate forest. Southern aspect with *Pinus wallichiana*, 8000ft elevation.

- (f) Himalayan moist temperate forest. Northern aspect with *Abies pindrow* forest and *Viburnum nervosum* undershrub.

## 3 Aspects of four major ecological zones at higher altitudes.

- (a) Alpine dry steppe forest in Northern latitudes with *Juniperus polycarpus* scrub forest on lower slopes. Shingai Garh valley, Gilgit, 12,000ft elevation.

- (b) Dry temperate coniferous forest with *Cedrus deodara*. Mankial, Swat Kohistan, 7500ft elevation.

- (c) Alpine meadows and permanent snow fields. Phandar, Gilgit, 11,000ft elevation.

- (d) Dry temperate coniferous forest with *Picea morinda* spruce and *Hippophae rhamnoides* bushes in foreground. Naltar Valley, Gilgit, 7000ft elevation.

- (e) Sub-alpine scrub zone, with *Betula utilis* and *Salix* species. Miran Jani, Murree Hills, 10,000ft elevation.

- (f) Alpine meadow zone with dwarf *Juniperus* scrub. Above Saif-ul-Mulk, Hazara District, 11,000ft elevation.

## 4 Map of Pakistan showing nine major ecological or vegetative zones.

# LIST OF DISTRIBUTION MAPS

| Number | Page   | Number | Page |
|--------|--|--------|------|
| 1      | <i>Hemiechinus auritus collaris</i> — Long-eared or Desert Hedgehog.   |        |      |
|        | <i>Hemiechinus megalotis</i> — Afghan Hedgehog.  |        |      |
| 2      | <i>Paraechinus micropus</i> — Indian or Pale Hedgehog.   |        |      |
| 3      | <i>Paraechinus hypomelas blanfordi</i> — Blandford's Lesser Lowland Hedgehog.  |        |      |
|        | <i>Paraechinus hypomelas hypomelas</i> — Brandt's Greater Hedgehog.  |        |      |
| 4      | <i>Sorex minutus</i> — Pygmy Shrew or Lesser Shrew.  |        |      |
|        | <i>Crocidura russula</i> — Common White-toothed Shrew.   |        |      |
| 5      | <i>Suncus murinus</i> — House or Musk Shrew.   |        |      |
| 6      | <i>Suncus etruscus</i> — Savi's Pygmy, or Etruscan Shrew.  |        |      |
| 7      | <i>Crocidura persigsea</i> — Pale Grey Shrew.  |        |      |
|        | <i>Suncus stoliczkanus</i> — Anderson's Shrew or Yellow Throated Shrew.  |        |      |
| 8      | <i>Rousettus aegyptiacus arabicus</i> — Synonym <i>R. arabicus</i> — Egyptian Fruit Bat.                                   |        |      |
|        | <i>Rousettus leschenaulti</i> — Fulvous Fruit Bat.   |        |      |
| 9      | <i>Pteropus giganteus</i> — Indian Flying Fox.   |        |      |
| 10     | <i>Cynopterus sphinx</i> — Short Nosed Fruit Bat.  |        |      |
| 11     | <i>Rhinopoma microphyllum</i> — Larger Mouse-tailed or Rat-tailed Bat.   |        |      |
| 12     | <i>Rhinopoma hardwickei</i> — Lesser Mouse-tailed or Rat-tailed Bat.   |        |      |
| 13     | <i>Taphozous perforatus</i> — Tomb Bat or Egyptian Tomb Bat.   |        |      |
| 14     | <i>Taphozous kachhensis</i> — Kutch Sheath-tailed Bat.   |        |      |
| 15     | <i>Megaderma lyra</i> — Indian False Vampire.  |        |      |
| 16     | <i>Rhinolophus ferrumequinum</i> — Greater Horseshoe Bat.  |        |      |
| 17     | <i>Hipposideros fulvus</i> Synonym <i>H. bicolor</i> — Bi-coloured Leaf-nosed bat or Bi-coloured Round-leaf Horseshoe Bat. |        |      |
| 18     | <i>Asellia tridens</i> — Trident Leaf-nosed Bat.   |        |      |
| 19     | <i>Tadarida aegyptiaca</i> — Egyptian Free-tailed or Wrinkle-lipped Bat.   |        |      |
| 20     | <i>Myotis mystacinus</i> — Whiskered Bat.  |        |      |
|        | <i>Myotis emarginatus</i> — Geoffroy's Bat or Notch-eared Bat.   |        |      |
| 21     | <i>Eptesicus serotinus</i> — Serotine.   |        |      |
|        | <i>Eptesicus nasutus</i> — Sind Bat or Persian Serotine.   |        |      |
|        | <i>Eptesicus isabellinus bottae</i> — Isabelline Serotine or Botta's Serotine.   |        |      |
| 22     | <i>Nyctalus leisleri</i> — Lesser Noctule or Hairy-armed Bat.  |        |      |
|        | <i>Nyctalus noctula</i> — Common Noctule.  |        |      |
| 23     | <i>Pipistrellus pipistrellus</i> — Common Pipistrelle.   |        |      |
|        | <i>Pipistrellus dormeri</i> — Dormer's Bat.  |        |      |
| 24     | <i>Pipistrellus coromandra</i> — Indian Pipistrelle.   |        |      |
| 25     | <i>Pipistrellus mimus</i> — Indian Pygmy Pipistrelle.  |        |      |
| 26     | <i>Pipistrellus ceylonicus</i> — Kelaart's Pipistrelle.  |        |      |
| 27     | <i>Pipistrellus kubli</i> — Kuhl's Pipistrelle.  |        |      |
| 28     | <i>Pipistrellus babu</i> — Himalayan Pipistrelle.  |        |      |
| 29     | <i>Barbastella leucomelas</i> — Asian Barbastelle or Asiatic Wide-eared Bat.   |        |      |
| 30     | <i>Nycticeius pallidus</i> — Yellow Desert Bat.  |        |      |
| 31     | <i>Scotophilus kublii</i> Synonym <i>Scotophilus temmincki</i> — Temminck's House Bat or Lesser Yellow Bat.                |        |      |
| 32     | <i>Scotophilus beathi</i> — Common Yellow-bellied Bat or Desert Scotophil or Greater Yellow Bat.                           |        |      |
| 33     | <i>Otonycteris hemprichi</i> — Hemprich's Long-eared Bat or Arrow-eared Bat.   |        |      |
| 34     | <i>Plecotus austriacus</i> — Grey Long-eared Bat.  |        |      |
| 35     | <i>Murina buttoni</i> — Peters' Tube-nosed Bat.  |        |      |
| 36     | <i>Macaca mulatta villosa</i> — Himalayan Rhesus.  |        |      |
| 37     | <i>Presbytis entellus ajax</i> — Kashmir Grey Langur.  |        |      |
| 38     | <i>Manis crassicaudata</i> — Indian Pangolin or Scaly Anteater.  |        |      |
| 39     | <i>Canis lupus pallipes</i> — Wolf.  |        |      |
| 40     | <i>Canis aureus</i> — Asiatic Jackal.  |        |      |
| 41     | <i>Vulpes vulpes pusilla</i> — Desert or White-footed Fox.   |        |      |
|        | <i>Vulpes vulpes griffithi</i> — Hill or Kashmir Fox.  |        |      |
|        | <i>Vulpes vulpes montana</i> — Tibetan Red Fox.  |        |      |
| 42     | <i>Vulpes bengalensis</i> — Indian or Bengal Fox.  |        |      |
|        | <i>Vulpes cana</i> — Blandford's or King Fox.  |        |      |
|        | <i>Vulpes rüppelli</i> — Rüppell's or Sand Fox.  |        |      |
| 43     | <i>Ursus arctos</i> — Red or Brown Bear.   |        |      |
|        | <i>Selenarctos thibetanus</i> — Himalayan Black Bear.  |        |      |
| 44     | <i>Martes foina</i> — Beech or Stone Marten.   |        |      |
| 45     | <i>Martes flavigula</i> — Yellow-throated Marten (formerly known as White-cheeked Marten).                                 |        |      |
| 46     | <i>Mustela erminea</i> — Stoat or Ermine.  |        |      |
| 47     | <i>Mustela altaica</i> — Alpine or Pale Weasel — known as Altai Weasel in the USSR.  |        |      |
| 48     | <i>Vormela peregusna</i> — Marbled Pole-cat or Sarmantier.   |        |      |
| 49     | <i>Mellivora capensis</i> Ratel or Honey Badger.   |        |      |
| 50     | <i>Lutra lutra kutab</i> — Common (or Himalayan) Otter.  |        |      |
|        | <i>Lutra perspicillata</i> — Smooth-coated or Indian Otter.  |        |      |
| 51     | <i>Viverricula indica</i> — Small Indian Civet or Rasse.   |        |      |
|        | <i>Paguma larvata wroughtoni</i> — Himalayan Palm Civet.   |        |      |
| 52     | <i>Herpestes auropunctatus</i> — Small Indian or Gold Speckled Mongoose.   |        |      |
| 53     | <i>Herpestes edwardsi</i> — Indian Grey Mongoose.  |        |      |
| 54     | <i>Hyaena hyaena</i> — Striped Hyaena.   |        |      |
| 55     | <i>Felis libyca</i> — Indian Desert Cat.   |        |      |
| 56     | <i>Felis chaus</i> — Jungle Cat.   |        |      |
| 57     | <i>Felis manul</i> — Pallas's Cat.   |        |      |
|        | <i>Felis margarita</i> — Sand Cat or Dune Cat.   |        |      |
| 58     | <i>Felis lynx</i> — Lynx.  |        |      |
| 59     | <i>Felis caracal</i> — Caracal or Red Lynx.  |        |      |
| 60     | <i>Felis bengalensis</i> — Leopard Cat.  |        |      |
|        | <i>Felis viverrina</i> — Fishing Cat.  |        |      |
| 61     | <i>Panthera pardus</i> — Panther or Leopard.   |        |      |
| 62     | <i>Panthera uncia</i> — Snow Leopard or Ounce.   |        |      |
|        | <i>Acinonyx jubatus</i> — Cheetah.   |        |      |
| 63     | <i>Equus hemionus</i> — Asiatic Wild Ass or Onager.  |        |      |
| 64     | <i>Sus scrofa</i> — Wild Boar or Indian Wild Pig.  |        |      |
| 65     | <i>Moschus moschiferus</i> — Musk Deer.  |        |      |
| 66     | <i>Muntiacus muntjak</i> — Barking Deer or Muntjac.  |        |      |
|        | <i>Cervus elaphus banglu</i> — Hangul or Kashmir Stag.   |        |      |
|        | <i>Cervus duvauceli</i> — Swamp Deer or Barasingha.  |        |      |



| Number | Page   | Number | Page   |
|--------|--|--------|--|
| 67     | <i>Axis porcinus</i> — Hog Deer or Para. 174   | 91     | <i>Apodemus sylvaticus</i> — Wood or Field Mouse. 254                                      |
| 68     | <i>Boselaphus tragocamelus</i> — Nilgai or Blue Bull. 177                                | 92     | <i>Millardia (Rattus) meltada</i> — Soft-furred Field Rat or Metad. 257                    |
| 69     | <i>Antilope cervicapra</i> — Blackbuck. 179  | 93     | <i>Millardia (Rattus) gleadowi</i> — Sand-coloured Rat. 258                                |
| 70     | <i>Gazella gazella</i> — Indian Gazelle or Chinkara. 182                                 | 94     | <i>Rattus rattus</i> — Roof Rat or House Rat. 260  |
|        | <i>Gazella subgutturosa</i> — Goitred or Persian Gazelle. 182                            | 95     | <i>Rattus turkestanicus</i> — Synonym <i>Rattus rattoides</i> — Turkestan Rat. 260         |
| 71     | <i>Naemorbedus goral</i> — Grey Goral. 186   |        | <i>Rattus norvegicus</i> — Brown Rat or Norway Rat. 260                                    |
| 72     | <i>Capra bircus</i> — Wild Goat or Persian Pasang. 190                                   | 96     | <i>Mus musculus</i> — House Mouse. 263   |
| 73     | <i>Capra ibex sibirica</i> — Himalayan or Siberian Ibex. 193                             | 97     | <i>Mus booduga</i> — Little Indian Field Mouse. 265  |
| 74     | <i>Capra falconeri</i> , subspecies: 197   | 98     | <i>Mus cervicolor</i> — Fawn-coloured Mouse. 265   |
|        | <i>C.f. falconeri</i> — Astor Markhor. 197   | 99     | <i>Mus platythrix</i> — Indian Brown Spiny Mouse. 266                                      |
|        | <i>C.f. cashmirensis</i> — Pir Panjal Markhor. 197                                       | 100    | <i>Golunda ellioti</i> — Bush Rat or Golunda. 269  |
|        | <i>C.f. megaceros</i> — Kabul Markhor. 197   | 101    | <i>Acomys cabirinus</i> — Synonym <i>Acomys dimidiatus</i> — Cairo Spiny Mouse. 270        |
|        | <i>C.f. jerdoni</i> — Straight-horned Markhor. 197                                       | 102    | <i>Bandicota bengalensis</i> — Lesser Bandicoot or Indian Mole Rat. 273                    |
|        | <i>C.f. chialtanensis</i> — Chiltan Markhor. 197   | 103    | <i>Nesokia indica</i> — Short-tailed Mole Rat. 275   |
| 75     | <i>Pseudois nayaur</i> — Bharal or Blue Sheep. 202                                       | 104    | <i>Calomyscus bailwardi</i> — Mouse-like Hamster or Long-tailed Hamster. 278               |
| 76     | <i>Ovis orientalis</i> — Urial or Shapu. 205   | 105    | <i>Cricetulus migratorius</i> — Migratory or Grey Hamster. 280                             |
|        | <i>Ovis ammon polii</i> — Marco Polo's or Great Pamir Sheep. 205                         | 106    | <i>Gerbillus nanus</i> — Baluchistan Gerbil. 282   |
| 77     | <i>Lepus nigricollis dayanus</i> — Desert Hare. 210                                      | 107    | <i>Gerbillus cheesmani</i> — Cheesman's Gerbil. 283  |
|        | <i>Lepus capensis</i> — Cape Hare. 210   |        | <i>Gerbillus gleadowi</i> — Indian Hairy-footed Gerbil. 287                                |
| 78     | <i>Ochotona roylei</i> — Royle's or Indian Pika. 215                                     | 108    | <i>Tatera indica</i> — Indian Gerbil or Antelope Rat. 287                                  |
|        | <i>Ochotona rufescens</i> — Afghan or Collared Pika. 215                                 | 109    | <i>Meriones persicus</i> — Persian Jird. 289   |
| 79     | <i>Petaurista petaurista</i> — Giant Red Flying Squirrel. 219                            |        | <i>Meriones hurrianæ</i> — Indian Desert Jird. 292   |
| 80     | <i>Hylopetes fimbriatus</i> — Small Kashmir Flying Squirrel. 224                         | 110    | <i>Meriones libycus</i> — Libyan Jird. 292   |
| 81     | <i>Eupetaurus cinereus</i> — Woolly Flying Squirrel. 226                                 | 111    | <i>Meriones crassus</i> — Sundevall's Jird. 293  |
| 82     | <i>Funambulus pennanti</i> — Northern Palm Squirrel or Five-striped Palm Squirrel. 227   | 112    | <i>Rhombomys opimus</i> — Great Gerbil or Giant Day Jird. 294                              |
| 83     | <i>Marmota caudata</i> — Long-tailed or Kashmir Marmot. 230                              | 113    | <i>Ellobius fuscocapillus</i> — Quetta Mole Vole or Afghan Mole Vole. 296                  |
|        | <i>Marmota cobak</i> — Himalayan or Bobak Marmot. 230                                    | 114    | <i>Alticola roylei</i> — Royle's High Mountain Vole. 299                                   |
| 84     | <i>Hystrix indica</i> — Indian crested Porcupine. 235                                    | 115    | <i>Hyperacrius wynnei</i> — Murree or Wynne's Vole. 301                                    |
| 85     | <i>Sicista concolor</i> — Chinese Birch Mouse. 238                                       | 116    | <i>Hyperacrius fertilis</i> — True's Vole or Burrowing Vole. 303                           |
| 86     | <i>Salpingotus michaelis</i> — FitzGibbon's Pygmy Jerboa or Dwarf Three-toed Jerboa. 239 | 117    | <i>Platanista gangetica</i> — Synonym <i>Platanista indi</i> — Indus Dolphin or Su-Su. 310 |
| 87     | <i>Allactaga elater</i> — Small Five-toed Jerboa. 244                                    | 118    | <i>Neomeris phocaenoides</i> — Black Finless Porpoise or Little Indian Porpoise. 314       |
| 88     | <i>Allactaga hotsoni</i> — Hotson's Five-toed Jerboa. 245                                |        |  |
| 89     | <i>Jaculus blanfordi</i> — Blandford's Jerboa or Greater Three-toed Jerboa. 246          |        |  |
| 90     | <i>Dryomys nitedula</i> — Forest Dormouse. 249   |        |  |

# 1 INTRODUCTION

Pakistan came into existence as an independent sovereign state in 1947. The west wing of that country, formerly known as West Pakistan, is the region exclusively treated by this book. It covers an area of 310,403 square miles, being about equal to the combined areas of France, Belgium and Britain. Roughly rhomboidal in shape, Pakistan forms a bridge between the Middle East and the Orient, stretching in the extreme western tip of Baluchistan from longitude  $60^{\circ} 52'$  to longitude  $75^{\circ} 22'$  in the north eastern corner of the Punjab. It stretches from  $24^{\circ}$  latitude on the arid cliffs of the Arabian sea coast up to  $37^{\circ}$  latitude in the north, where the frontiers reach the permanent snow fields of the Pamir Wakhan.

The great Indus River and its drainage basin forms a dominant physiographic feature over a large part of the country. Most of the regions west of the Indus River are rocky and mountainous and not amenable to extensive cultivation or dense human settlement since the whole of Pakistan experiences a relatively arid subtropical climate. Despite this unfavourable climate, the region has a very long history of human settlement along the rich alluvial banks of the Indus flood plain. Evidence of mankind's earliest civilized culture dating from B.C. 3,000 have been excavated from settlements along the Indus at Harappa and Mohenjo Daro. For many centuries primitive mankind existed in this region in a state of relative ecological equilibrium and it was not until the last four or five decades of this century that Pakistan experienced profound and accelerating ecological changes resulting from the greatly increased human population. Major irrigation systems have been built, tapping the Indus water resources and all its tributaries. Within the last decade two of the world's largest earth-filled dams and water storage reservoirs have been constructed, and they will have far-reaching effects on all but the northernmost regions of Pakistan. At the time of writing there has been no detailed study of the ecological consequences of such major water storage schemes. However the increase in the area available for irrigated cultivation and virtual control of monsoon river flooding, has already resulted in the disappearance of extensive tracts of the original tropical thorn scrub, and riverine swamp and forest areas. The mammalian population, particularly the larger species of oriental faunal origin, have declined dramatically as a result of loss of suitable habitat and increased human disturbance. Even in the mountainous regions to the west of the Indus there is increased competition for available fodder from domestic grazing flocks. Nearly all the people dwelling in these mountainous areas are, moreover, natural sportsmen and skilled marksmen with a tradition for hunting which has accelerated the extermination of many of the larger forms of wildlife, including birds and mammals. Against such a background of dwindling wildlife resources, it appears all the more necessary to attempt an assessment of the mammalian fauna of the region, and that is the major objective of this book.

Human population pressure is increasing, and in April 1973 the government announced the results of a population census carried out in September 1972 which revealed a population of 64,890,000, a truly alarming figure since this represented an increase of nearly 51.33 per cent since the last official census of 1960. It also indicates an average annual growth rate of 3.7 per cent which is one of the high-

est of any of the developing countries in the world. Demand for fuel-wood resources from the scanty vegetation in Baluchistan and the North West Frontier Province has already led to total denudation of many hillsides which were formerly clothed with scattered scrub forest. This has aggravated erosion problems which in turn reduces the efficacy of the ground water recharging cycle. Since these changes are having a profound influence on the mammalian population, besides limiting future resource use and availability for human needs, it is sincerely hoped that more careful long range planning and consideration will be given to this overall problem of resource exploitation. Reference to many of the books written about this region at the turn of the century corroborates the evidence of profound change. The foothills a few miles northwest of Peshawar were then thickly covered with forests of wild olive, in which the Asiatic wild sheep (*Ovis orientalis*), the Markhor wild goat (*Capra falconeri*), and the Chinkara gazelle (*Gazella gazella*) roamed. They could be hunted within one day's horseback ride from Peshawar town (Warburton, 1898). Today these hills are devoid of a single bush taller than 1m and there are no Chinkara or Urial even within a day's car journey from Peshawar, though a very few Markhor survive on some relatively precipitous mountain peaks. Many of the local people living in these hills of the Khyber Valley insist that they have always been bare of vegetation.

Despite this gloomy picture Pakistan still has a rich and varied mammalian fauna, affinitive to two of the major faunal regions, namely the Palearctic region west of the Indus and the Oriental region east of the Indus. Ten of the 18 mammalian orders are represented in Pakistan, including not only the world's smallest surviving mammal, the Mediterranean Pigmy Shrew (*Suncus etruscus*), but also in her coastal waters the largest mammal ever known to exist, the Blue Whale (*Balaenoptera musculus*).

Prior to 1947 considerable information regarding the mammals of the Indian subcontinent had been accumulated. The history of the development of our knowledge of Indian fauna (in the sense of the whole subcontinent) starts with the publication in 1847 of Jerdon's *The Mammals of India*. A surgeon by profession, he described 103 species so accurately that his contribution has been of lasting value. In 1884 Sterndale published his *Natural History of the Mammalia of India and Ceylon*, which had many illustrations and was written in more popular style. Much interesting data on wild animals was recorded from 1905 onwards with the formation of the Asiatic Society of Bengal, which produced a quarterly journal devoted to natural history and published from Calcutta where the British East India Company had its headquarters. A few years earlier, in 1886, the Bombay Natural History Society was formed with similar objectives. It was not until the turn of the century that the Bombay Society began to supersede in importance the publications of the Calcutta Society. From 1912 the Bombay Natural History Society sponsored a mammal survey of the subcontinent. Interrupted by World War I this survey continued in the late 1920s and early 1930s, with detailed collecting of small mammals being carried out in selected regions, which fortunately included several districts which now form part of Pakistan. The published results of these surveys exist in

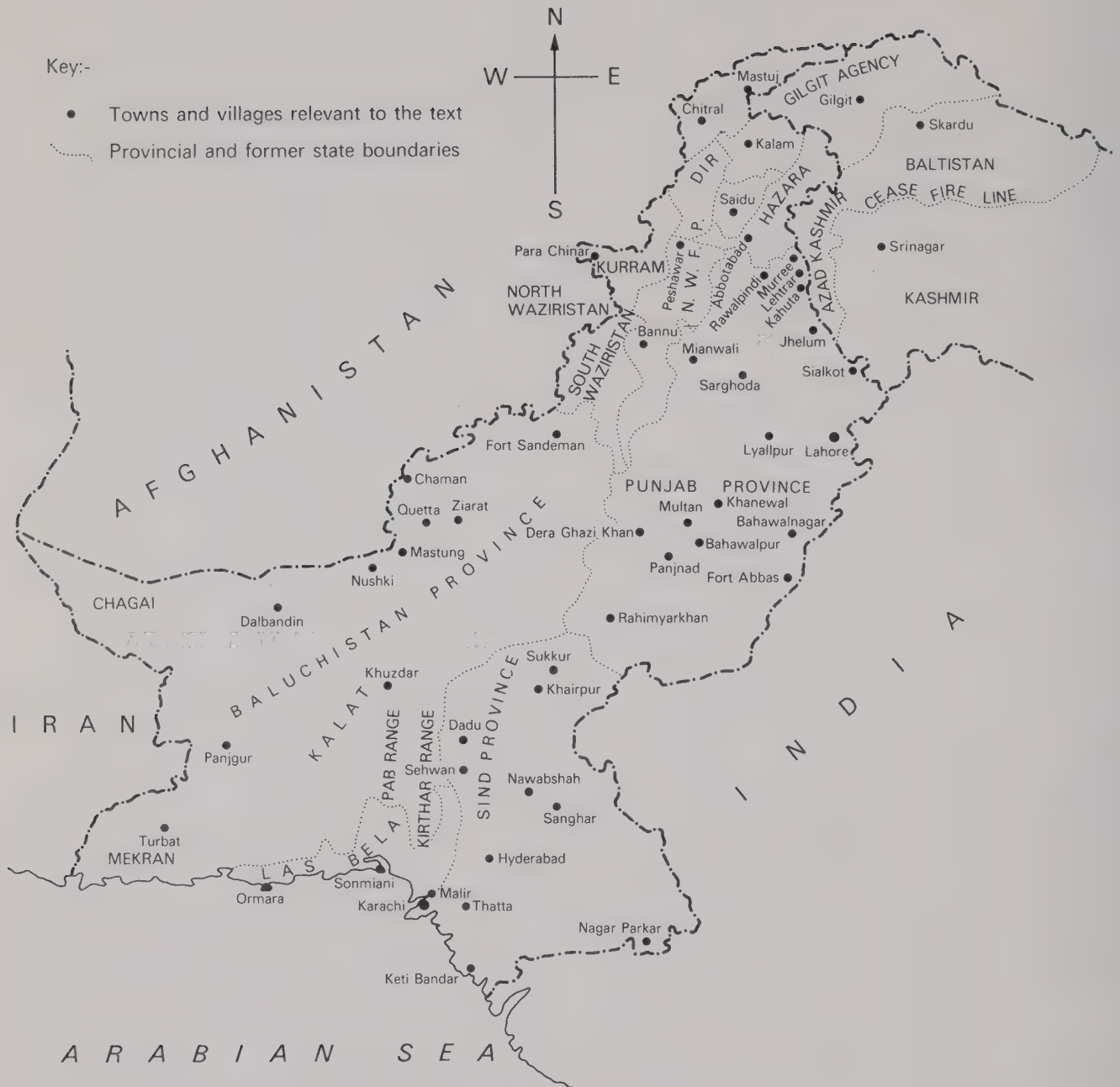


Fig. 1 Map of Pakistan showing provincial and former native state boundaries and important towns.

the various volumes of the *Journal of the Bombay Natural History Society*, particularly Volume 24 (northern Sind region), Volume 27 (south western Baluchistan), and Volume 31 (the Punjab Salt Range).

Before the outbreak of World War II the government of British India embarked on a programme to publish a series of volumes covering the fauna of the region. Two volumes by Pocock (1939 and 1949) were published in this series,

covering primates and carnivora. Two additional volumes covering the rodentia were produced by Ellerman (1961) under the same fauna series. Ellerman's works contain valuable keys as well as tables of measurements of specimens collected, though little reference is made to field habits or distribution. Perhaps the most valuable contribution to the knowledge of the region's mammalian fauna came with the publication by Prater (1948) of an illustrated and popular



edition sponsored by the Bombay Natural History Society. This book was partly revised and a second edition published in 1965 which is beautifully illustrated by Paul Barruel. This volume is virtually unobtainable in Pakistan because it was published in Bombay. It contains a valuable generalized account of the natural history and inter-relationships of the main mammalian orders, but the treatment of bats and rodents is necessarily rather condensed and brief.

The Zoological Survey Department of Pakistan was established in 1947 with headquarters in Karachi. Its first director Dr. Ranjha was a marine biologist by training but he was able to make considerable progress in building up a library as well as making a collection of study specimens. His successor, Mr. M. S. Siddiqi, published the first checklist of mammals of both wings of the country (1961). This work was based almost exclusively on the British Museum (Natural History) collections existing at that time. From 1964 to 1966 the University of Maryland carried out extensive collecting of small mammals in Pakistan under a United

States' medical research project for study of ecto- and endoparasites. This collection is now housed in the Smithsonian National Museum but up to the time of writing nothing has been published regarding these specimens, many of which came from regions which had hitherto not been surveyed. Mr. Z. B. Mirza who worked with the University of Maryland Expedition published in Urdu (1970) a volume covering the small mammals of West Pakistan (Rodentia, Chiroptera, Insectivora, Lagomorpha, Primates and Pholidota). A second volume, covering the Carnivora and Ungulates is under preparation by the same author.

The chapters of this book deal with 158 species, including 43 rodents, 36 bats, 18 artiodactyla, one perissodactyla, 31 carnivora, 11 insectivora, one pholidota, two primates and nine cetaceans. It contains several large mammals which are not mentioned in S. H. Prater's revised edition, as well as two species of insectivora, 15 of chiroptera, two artiodactyla, two carnivora and four rodent species not included in Siddiqi's checklists (1961 and 1970) for West Pakistan.

## 2 ZOOGEOGRAPHICAL ASPECTS AND FAUNAL ORIGINS

The present varied and interesting composition of the mammalian fauna of Pakistan is largely due to its role as a transitional zone between two of the world's six major zoogeographical regions, the Palearctic and the Oriental, and further species have apparently also come from as far afield as the Ethiopian region. The present distribution of the fauna also owes much to these various origins as well as to the routes that the different species have had to take to overcome some important barriers to movement which more or less surround and form part of Pakistan. These obstacles are the mountain ranges of Baluchistan and of the North West Frontier Province to the west, the Himalayas to the north and the great Indian desert of Rajasthan (also known as the Sind Desert) to the east (see Fig. 2).

### Palearctic Element

The Palearctic fauna of Pakistan lives largely in the Himalayan and Baluchistan upland regions, and appears to have come from Iran through southern Baluchistan or down through the Himalayas from the Hindu Kush Mountains and Russian Uzbekistan. The species which have invaded by the northern route include the European Brown Bear (*Ursus arctos*), the Common Otter (*Lutra lutra*), the Alpine Weasel (*Mustela altaica*), the Stoat (*Mustela erminea*), the Lynx (*Felis lynx*), the White-toothed Shrew (*Crocidura russula*), the Field Mouse (*Apodemus sylvaticus*), the Mole-vole (*Ellobius fuscicapillus*), the Grey Long-eared Bat (*Plecotus austriacus*), the Mountain Noctule (*Nyctalus montanus*) and the Eastern Barbastelle (*Barbastella leucomelas*). Those which have come by southern Baluchistan are adapted to more arid conditions and a warmer climate. Some of these have Mediterranean affinities and include the Persian Wild Goat (*Capra hircus*), the Marbled Pole-cat (*Vormela peregusna*), the Beech or Stone Marten (*Martes foina*), the Forest Dormouse (*Dryomys nitedula*), the Egyptian Spiny Mouse (*Acomys cahirinus*), the Migratory Hamster (*Cricetulus migratorius*) as well as the Etruscan Pigmy Shrew (*Suncus etruscus*), Blasius's Horseshoe Bat (*Rhinolophus blasii*), the Greater Horseshoe Bat (*Rhinolophus ferrum-equinum*) and the Trident Leaf-nosed Bat (*Asellia tridens*).

Other mammals using the southern route seem to have had their centre of origin in the great deserts of North Africa as well as the Great Iranian Desert. Being highly adapted to desert conditions these have only succeeded in colonizing the south western border regions of Pakistan without penetrating the mountain hinterland. They include several species not found elsewhere in the subcontinent, such as Rüppell's Sand Fox (*Vulpes rüppelli*), the Sand Cat (*Felis margarita*), the Libyan Jird (*Meriones libycus*), several species of Jerboa (*Jaculus* and *Allactaga*), Cheesman's Gerbil (*Gerbillus cheesmani*) and the Egyptian Rousettus Bat (*Roussettus aegyptiacus*) as well as the much more widely distributed Indian Gazelle (*Gazella gazella*).

### Oriental Element

Many oriental faunal zone species have failed to cross the Indian desert region, but others appear to have colonized Pakistan by two invasion routes where vegetation and climate afforded a more moderating bridge. One such route,

lying in the extreme south, comprises the seacoast with its mangrove littoral and its immediate hinterland of savannah-type vegetation in the Rann of Kutch. The other lies in the north where the Himalayan foothills intercept the monsoon rains and as a result carry some subtropical deciduous or sclerophyllous forest.

The southern route was used by the Swamp-deer (*Cervus duvauceli*) which colonized the Indus riverine tracts up to the forests of Sukkur whilst the Tiger extended its range as far as Panjnad on the Indus River even within this century. Both these species regrettably no longer occur in Pakistan. The Fishing Cat (*Felis viverrina*), Hog Deer (*Axis porcinus*), Smooth-coated Otter (*Lutra perspicillata*), Musk Shrew (*Suncus murinus*), Pangolin (*Manis crassicaudata*), Lesser Bandicoot Rat (*Bandicota bengalensis*), Bush Rat (*Golunda ellioti*), Soft-furred Field Rat (*Millardia meltada*), Bi-coloured Leaf-nosed Bat (*Hipposideros fulvus*) and the Indian False Vampire (*Megaderma lyra*) are examples of oriental mammals which still survive in Pakistan and which have entered by this route.

Turning to the northern invasion route we have the example of the Great Indian One-horned Rhinoceros (*Rhinoceros unicornis*) which became extinct in Pakistan about 400 years ago but was hunted by the Moghul Emperor Babur in the Vale of Peshawar. The Leopard Cat (*Felis bengalensis*), Yellow-throated Marten (*Martes flavigula*), Himalayan Palm Civet (*Paguma larvata*), Grey Goral (*Naemorhedus goral*) and Barking Deer (*Muntiacus muntjak*) still survive and also entered by this route. Similarly the Soft-furred Field Rat (*Millardia meltada*), Pangolin (*Manis crassicaudata*), Bush Rat (*Golunda ellioti*), Flying Fox (*Pteropus giganteus*) and the Indian False Vampire Bat (*Megaderma lyra*) have entered the region from the plains adjacent to those foothills in the north eastern corner.

There is a third group of oriental species which are better adapted to desert conditions and presumably as a result have managed to invade Pakistan all along the eastern border. They include the Nilghai (*Boselaphus tragocamelus*), Blackbuck (*Antelope cervicapra*) and the Small Indian Civet (*Viverricula indica*). In fact the two former species are still trying to colonize Pakistan but are under severe hunting pressure.

### Ethiopian Element

Those mammals having greater affinities with the Ethiopian region must have invaded Pakistan from the west, and presumably entered along the Mekran coastal belt. They include the Lion (*Panthera leo*) which is now extinct in Pakistan but still survives precariously in Kathiawar, and the Cheetah (*Acinonyx jubatus*) which may be extinct throughout India and Pakistan. Also the Caracal Cat (*Felis caracal*), the Jungle Cat (*Felis chaus*), the Ratel (*Mellivora capensis*), the Long-eared Hedgehog (*Hemiechinus auritus*) and the Cape Hare (*Lepus capensis*) and possibly the Wrinkle-lipped Bat (*Tadarida aegyptiaca*) and the Mouse-tailed Bat (*Rhinopoma hardwickei*).

### Effects of Altitude

Changes in altitude mean changes in climate which in turn affects the type of vegetation and its associated fauna. Pakistan has some of the world's highest cold areas and

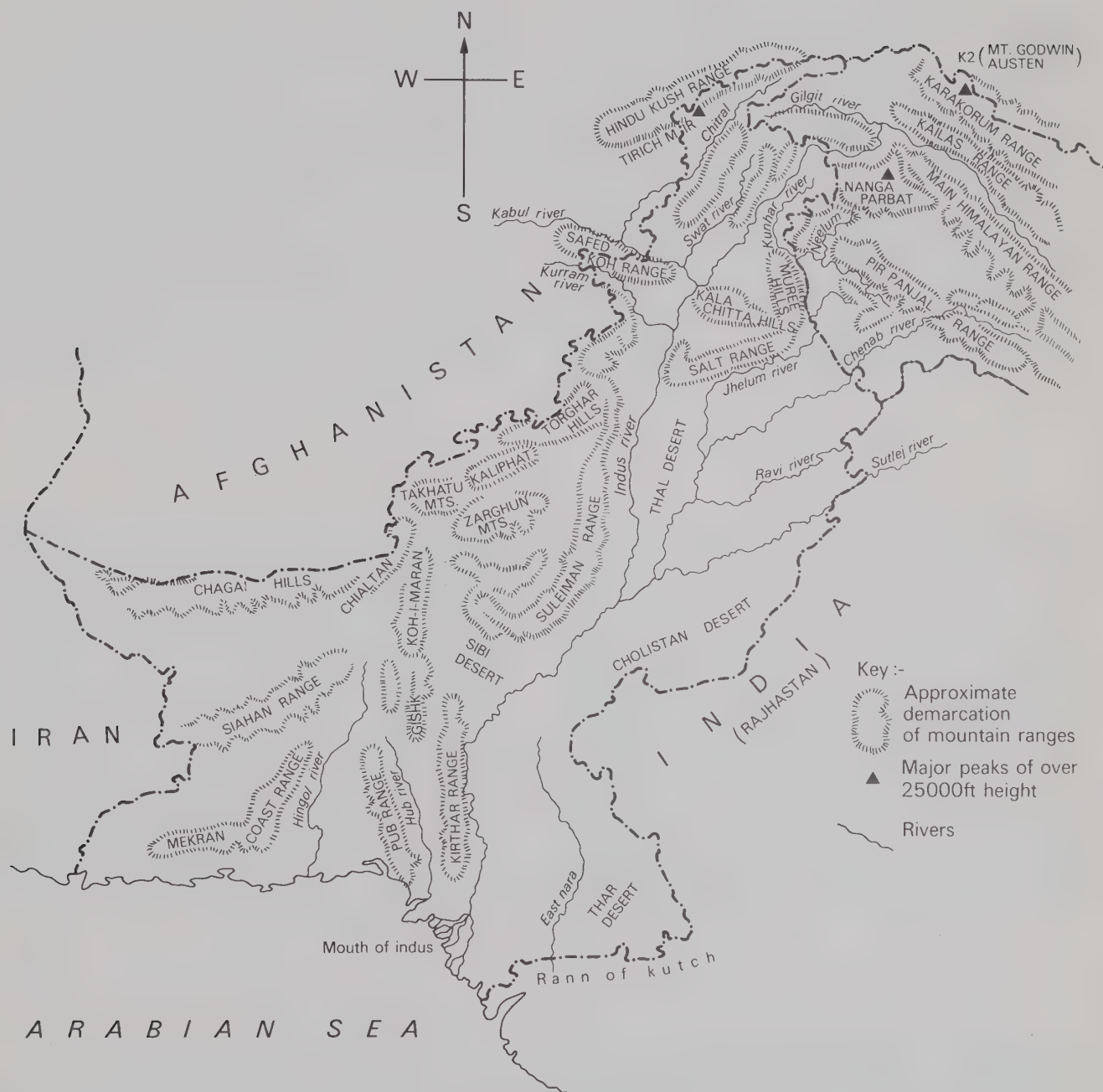


Fig. 2 Map of Pakistan showing main rivers, hills and mountain ranges.

hottest low areas, and many intermediate stages. Within a relatively small area, therefore, it has equivalents of many of the world's most important climatic and vegetational zones or biomes (Farb, 1965 and Pfeffer, 1968), and some interesting comparisons can be made, including those of the mammalian faunas. Thus we see the Arctic zone mirrored in areas of permanent snow and ice which occur above 17,000ft in the Himalayas. Below this there is alpine meadow and scrub with its Red Fox (*Vulpes vulpes montana*), Himalayan Lynx (*Felis lynx*) and Mouse Hare (*Ochotona roylei*), which is equivalent to the Tundra biome with its comparable mammals,

the Siberian race of the Red Fox (*Vulpes vulpes daurica*), the Lynx (*Felis lynx*) and the Siberian Pika (*Ochotona hyperborea*) (Pfeffer, 1968).

Next comes the dry coniferous forest, with a race of Red Deer (*Cervus elaphus*) now almost extinct in the Pakistan part of the Himalayas (see page 175), the Alpine or Altai Weasel (*Mustela altaica*) and the Small Kashmir Flying Squirrel (*Hylopetes fimbriatus*), which can be compared with the boreal forest biome or Taiga harbouring another race of the Red Deer, the Musk Deer (*Moschus moschiferus*), the same Alpine Weasel and the Boreal Flying Squirrel



(*Pteromys volans*). Further down is the moist temperate Himalayan forest with such species as the Leopard (*Panthera pardus*), the Tibetan or Black Bear (*Selenarctos thibetanus*) and the Giant Red Flying Squirrel (*Petaurista petaurista*), which is equivalent to the deciduous forest biome with similar mammal species.

The lower sclerophyllus forest zone of Pakistan was formerly inhabited by such grazing ungulates as the Nilghai (*Boselaphus tragocamelus*), wild sheep (*Ovis orientalis*) and the Grey Goral (*Naemorhedus goral goral*), and these can be considered as the ecological equivalents of the grazing antelopes and other ungulates of the savannah biome in the southern hemisphere.

Finally it should perhaps be mentioned that equally useful comparisons can be made between the mammals of the Himalayas and those of the major European mountain masses. Thus, for example, the Long-tailed Marmot (*Marmota caudata*) and the Himalayan Ibex (*Capra ibex sibirica*) have close relatives in the Alps of Western Europe, whilst the Himalayan Goral (*Naemorhedus goral*) though belonging to a different genus is ecologically equivalent to the Chamois (*Rupicapra rupicapra*).

### Habitat Types and Associated Mammals

Some of the major ecological zones of Pakistan have already been mentioned in the last section. It is now proposed to break them down into more discrete units characterized by particular species of plants and mammals. Such units cannot be grouped into continuous ecological zones, but split up the whole region into a patchwork of areas of similar ecological constitution (see Fig. 3) which from the point of view of the associated mammals can be regarded as distinct habitats necessary for their well-being and determining their distribution.

The habitats and their groupings are based partly on the forest zones of Sir Harry Champion and others (1936 and 1965), the Himalayan vegetational zones of Dr. Schweinfurth (1957), and more particularly the zones as worked out by Dr. Rahman Beg (1975) of the Pakistan Forest Institute. The treatment of these ecologists has been modified and simplified, however, because many mammal species in Pakistan have had to adapt to relatively unfavourable ecological conditions, which are not always typical of the species in other parts of their range. In addition, large parts of Pakistan have been so heavily influenced by man as to constitute degraded vegetational zones, which cannot usefully be related to any distinct ecological climax from the point of view of mammalian distribution.

The resulting 18 more or less distinct types of habitat of Pakistan with their dominant plant species and their characteristic mammals are given below.

### A. PERMANENT SNOW AND COLD DESERT

1 *Permanent Snowfields and Cold Desert*. In northernmost regions and highest altitudes typified by the Karakoram Mountains and Hunza and northern Chitral. The vegetation is often more xerophytic than those alpine zones associated with smaller mountain masses.

*Plants:* *Salix denticulata*, *Juniperus communis*, *Mertensia tibetica*, *Potentilla desertorum*.

*Mammals:* On the periphery of this zone will be found the Himalayan Ibex (*Capra ibex sibirica*), Altai Weasel (*Mustela altaica*), Bobak Marmot (*Marmota bobak*), Bharal (*Pseudois nayaur*), Lynx (*Felis lynx*), and Snow Leopard (*Panthera uncia*).

### B. ALPINE ZONE

2 *Alpine Meadows*. Northern Hazara District and Gilgit, Chitral and Swat Kohistan and also in all regions where mountains extend above coniferous forest treeline.

*Plants:* Many annual grasses of *Poa* genus, and *Draba trinervia*, *Polygonum affine*, *Saxifraga sibirica*, *Euphorbia kanaorica*.

*Mammals:* Snow Leopard (*Panthera uncia*), Himalayan Ibex (*Capra ibex sibirica*), Red Bear (*Ursus arctos*), Long-tailed Marmot (*Marmota caudata*), Lesser Shrew (*Sorex minutus*), Royle's High Mountain Vole (*Alticola roylei*), Ermine (*Mustela erminea*), Chinese Birch Mouse (*Sicista concolor*).

3 *Sub-Alpine Scrub and Birch Forest*. Though widespread this always comprises a very limited or narrow zone confined often to small ravines on upper slopes throughout higher mountain ranges of the Himalayas including the north eastern corner of Hazara District, Gilgit and Swat Kohistan.

*Plants:* *Betula utilis*, *Rhododendron anthopogon*, *Juniperus communis*, *Sorbus aucuparia*, *Alopecurus* and *Poa* grasses with *Primula*, *Ranunculaceae* and *Anemone*.

*Mammals:* Royle's High Mountain Vole (*Alticola roylei*), True's Vole (*Hyperacrius fertilis*), Chinese Birch Mouse (*Sicista concolor*), Musk Deer (*Moschus moschiferus*), Snow Leopard (*Panthera uncia*), and Markhor (*Capra falconeri*).

### C. MONTANE TEMPERATE FOREST (the only real 'tall tree' forest in Pakistan)

4 *Dry Temperate Coniferous Forest*. Usually found in the inner ranges of the Himalayas with less monsoon influence and confined to the more sheltered lower slopes. Typified by upper reaches of Kaghan Valley, Jabba Valley in Swat, Gabriel, Dir, Chilas and Naltar Valley in Gilgit.

*Plants:* *Picea smithiana*, *Pinus wallichiana*, *Cedrus deodara*, with undershrubs of *Indigofera gerardiana*, *Sambucus ebulus*, *Sorbaria tomentosa*, *Plectranthus rugosus*.

*Mammals:* Royle's Pika (*Ochotona roylei*), Small Kashmir Flying Squirrel (*Hylopetes fimbriatus*), Himalayan Black Bear (*Selenarctos thibetanus*), Yellow Throated Marten (*Martes flavigula*), Long-tailed Field Mouse (*Apodemus sylvaticus*), and Turkestan Rat (*Rattus turkestanicus rattoides*).

5 *Himalayan Moist Temperate Forest*. Typical of the Galis, Lower Kaghan Valley, Shogran, Neelum Valley in Azad Kashmir, having mixed deciduous and coniferous forest and high rainfall during monsoon season.

*Plants:* *Quercus dilatata*, *Acer caesium*, *Populus ciliata*, *Taxus baccata*, *Pinus wallichiana* with undershrubs as *Berberis ceratophylla*, *Berberis lycium*, *Lonicera alpingena*, *Viburnum nervosum*, *Skimmia laureola*, *Fragaria*, *Viola* and *Impatiens* species.

*Mammals:* Yellow-throated Marten (*Martes flavigula*), Giant Red Flying Squirrel (*Petaurista petaurista*), Small Kashmir Flying Squirrel (*Hylopetes fimbriatus*), Leopard Cat (*Felis bengalensis*), Grey Langur (*Presbytis entellus*), Rhesus Macaque (*Macaca mulatta*), Himalayan Black Bear (*Selenarctos thibetanus*), Porcupine (*Hystrix indica*), Murree Vole (*Hyperacrius wynnei*), Turkestan Rat (*Rattus turkestanicus rattoides*), Long-tailed Field Mouse (*Apodemus sylvaticus*), Whiskered Bat (*Myotis*



Plate 1 Aspects of five major ecological zones at lower altitudes.



(a) Intertidal zone showing mangroves (*Avicennia officinalis*) at high tide in Indus mouth.



(b) Riverain and monsoon seasonal inundation zone, showing *Saccharum* grasses and *Prosopis* thorn scrub, 400ft elevation.



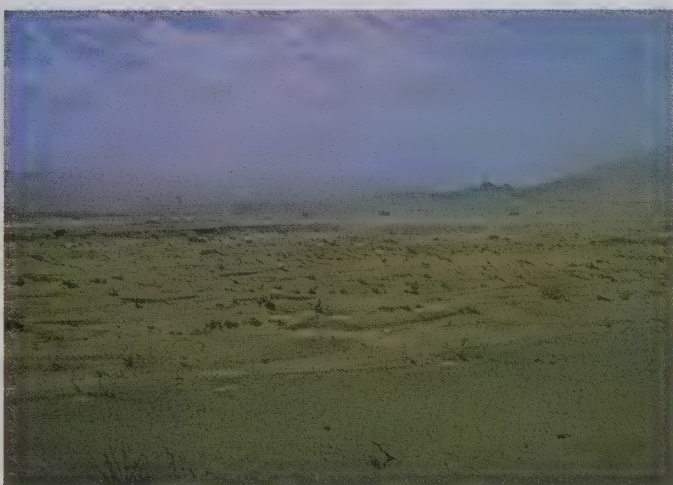
(c) Arid subtropical zone showing *Nannorrhops ritchieana* palm, Kirthar hills, 1000ft elevation.



(d) Tropical thorn forest in Salt Range with *Olea cuspidata* and *Acacia modesta*, 2500ft elevation.



(e) Baluchistan desert, stony peneplain near Dalbandin, 2500ft elevation.



(f) Baluchistan desert. Soft sand-dunes near Nushki, 3200ft elevation.





(a) Baluchistan desert scrub at 6000ft elevation. *Sophora griffithii* bush in foreground.



(b) Mountain steppe forest in southern latitudes. *Juniperus macropoda* trees with *Berberis baluchistani*, 8500ft elevation.



(c) Tropical dry deciduous scrub forest. Margala hills, 3000ft elevation with *Baubinia* and *Cassia* species and *Zizyphus mauritiana* undershrub.



(d) Subtropical pine forest interspersed with cultivation and orchards. *Pinus roxburghii* in background, 5000ft elevation.



(e) Himalayan moist temperate forest. Southern aspect with *Pinus wallichiana*, 8000ft elevation.



(f) Himalayan moist temperate forest. Northern aspect with *Abies pindrow* forest and *Viburnum nervosum* undershrub.





(a) Alpine dry steppe forest in Northern latitudes with *Juniperus polycarpus* scrub forest on lower slopes, Shingai Garh valley, Gilgit, 12,000ft elevation.



(b) Dry temperate coniferous forest with *Cedrus deodara*. Mankial, Swat Kohistan, 7500ft elevation.



(c) Alpine meadows and permanent snow fields. Phandar, Gilgit, 11,000ft elevation.



(d) Dry temperate coniferous forest with *Picea morinda* spruce and *Hippophae rhamnoides* bushes in foreground. Natar valley, Gilgit, 7000ft elevation.



(e) Sub-alpine scrub zone, with *Betula utilis* and *Salix* species. Miran Jani, Murree Hills, 10,000ft elevation.



(f) Alpine meadow zone with dwarf *Juniperus* scrub. Above Saif-ul-Mulk, Hazara District, 11,000ft elevation.



Plate 4 Map of Pakistan showing nine major ecological or vegetative zones.

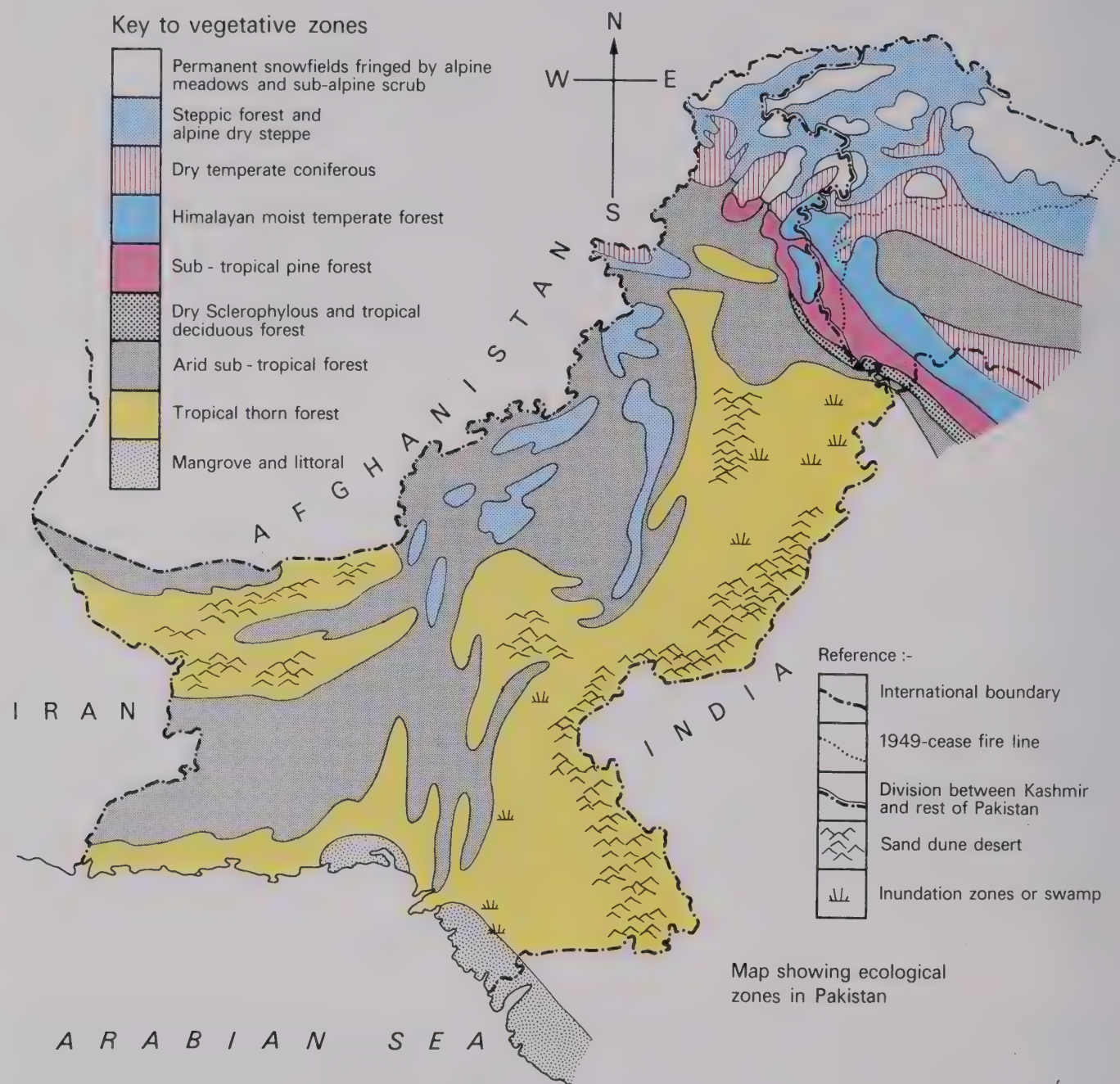




Fig. 4 Map of Pakistan showing main rivers, major sand-dune desert tracts with proposed or existing wild life sanctuaries and national parks.

*mystacinus*) and Grey Long-eared Bat (*Plecotus austriacus*).

6 *Sub-tropical Pine Forest*. A fairly narrow zone confined between about 3000ft and 6500ft. Typified by Batrasi Pass, Buner in Swat, Gora Gali and Tret.

Plants: *Pinus roxburghii*, *Quercus incana* with undershrubs of *Berberis heteropoda*, *Berberis lycium*, *Clematis gouriana*, *Carissa* spp., *Cotoneaster* spp. and clumps of grasses such as *Apluda aristata*, *Themeda anathera* and *Aristida cyanantha*.

Mammals: Grey Goral (*Naemorhedus goral*), Panther (*Panthera pardus*), Cape or Tibetan Hare (*Lepus capensis*), Yellow Throated Marten (*Martes flavigula*) and Himalayan Palm Civet (*Paguma larvata*).

D. TROPICAL DECIDUOUS FOREST

7 *Tropical Deciduous Forest*. This habitat is very restricted in area within Pakistan and is largely associated with the Jhelum Valley and the Rawalpindi foothills and outer Mar-



galla Hills. It is nevertheless of great ecological interest, as it has deciduous tree species of Indo-Malayan origin as well as some truly oriental mammal and bird species. It is typified by Kahuta and Lehtrar and Nurpur Shahan. On the dryer ridges the forest is dry sclerophyllus and it is only in the shadier ravines that some association of typical tropical deciduous species builds up. Early summer and spring is hot and dry but there is much rain in late summer (up to 37 in. in the year).

**Plants:** *Acacia modesta*, *Bauhinia variegata*, *Cassia fistula*, *Ficus carica*, *Shorea robusta*, *Salmalia malabarica*, *Sterculia villosa*, *Punica granatum*, and *Lannea coromandelica* with an understorey of *Dodonea viscosa*, *Woodfordia fruticosa*, *Carissa spinarum*, *Adhatoda vasica* and *Zizyphus mauritiana*.

**Mammals:** Barking Deer (*Muntiacus muntjak*), Wild Pig (*Sus scrofa*), Nilghai (*Boselaphus tragocamelus*) in Azad Kashmir only. Yellow-throated Marten (*Martes flavigula*), Leopard (*Panthera pardus*), and False Vampire Bat (*Megaderma lyra*).

## E. ALPINE DRY STEPPE

**8 Steppic Forest in Northern Latitudes.** Typified by side valleys of Lower Chitral, parts of Gilgit, Kohistan and Dir.

**Plants:** *Juniperus macropoda*, *Juniperus polycarpus*, *Pistacia integerrima*, *Quercus ilex*, *Pinus wallichiana*, *Plectranthus rugosus*, *Artemisia maritima*, *Hippophae rhamnoides* (in valleys), *Enneapogon persicum*, *Ephedra intermedia* and *Berberis* species.

**Mammals:** Markhor (*Capra falconeri*), Royle's Pika (*Ochotona roylei*), Forest Dormouse (*Dryomys nitedula*), Migratory Hamster (*Cricetulus migratorius*), Stone Marten (*Martes foina*), and Field Mouse (*Apodemus sylvaticus*).

**9 Steppic Forest in Intermediate Latitudes.** Typified by Takht-i-Suleiman, Toba Kakkar Range, Fort Sandeman, western border of Waziristan, parts of Safed Koh, Malakand and Swat.

**Plants:** *Juniperus macropoda*, *Fraxinus xanthoxyloides*, *Pinus gerardiana*, *Artemisia maritima*, *Rheum emodi*, *Ephedra nebrodensis*, *Rosa webbiana*, *Pennisetum orientale*, *Pistacia mutica*, *Thymus serpyllum*, *Eremurus aurantiacus*.

**Mammals:** Markhor (*Capra falconeri*), Collared Pika (*Ochotona rufescens*), Migratory Hamster (*Cricetulus migratorius*), Stone Marten (*Martes foina*), Forest Dormouse (*Dryomys nitedula*), Persian Jird (*Meriones persicus*) and Mouse-like Hamster (*Calomyscus bailwardi*).

**10 Steppic Forest in Southern Latitudes.** Typified by the higher mountain ranges of northern Kalat (Harboi and Gishk), Chiltan, Takhatu, Zarghun and Kaliphat Mountain ranges, also the higher parts of the Suleiman Hills.

**Plants:** Stunted *Juniperus macropoda*, *Pistacia khinjak*, *Berberis baluchistana*, *Prunus eburnea*, *Rosa webbiana*, *Tulipa* sp., *Iris* sp., *Eremurus stenophyllus*, *Artemisia scoparia* and grasses such as *Stipa pennata*, *Pennisetum orientale* and *Ephedra nebrodensis*.

**Mammals:** In extreme south Persian Wild Goat (*Capra bircus*), further north straight horned Markhor (*Capra falconeri jerdoni*) elsewhere Stone Marten (*Martes foina*), Persian Jirds (*Meriones persicus*), Collared Pikas (*Ochotona rufescens*), Migratory Hamsters (*Cricetulus migratorius*) Mouse-like Hamster (*Calomyscus bailwardi*), Afghan Hedgehog (*Hemiechinus megalotis*).

**F. ARID SUBTROPICAL HABITAT** (characterized by rocky and hilly country between sea level and about 3000ft elevation)

**11 Monsoon-influenced Arid Subtropical.** With humid summers, mild but dry winters. Typified by Karachi environs, Malir, Lakh Hills, Sind Kohistan, Kirthar, Las Belas.

**Plants:** *Euphorbia caducifolia*, *Zizyphus nummularia*, *Acacia senegal*, *Commiphora mukul*, and in valley bottoms *Nannorrhops ritchieana*, *Capparis decidua*, *Caragana ambigua*, *Haloxylon salicornicum*.

**Mammals:** Indian Fox (*Vulpes bengalensis*), Desert Cat (*Felis libyca*), Chinkara (*Gazella gazella*), Pangolin (*Manis crassicaudata*), Hyaena (*Hyaena hyaena*), Ratel (*Mellivora capensis*), Sind Ibex (*Capra hircus*), Porcupine (*Hystrix indica*), Bush Rat (*Golunda ellioti*), Spiny Mouse (*Acomys cabirinus*), Baluchistan Gerbil (*Gerbillus nanus*), Trident Leaf-nosed Bat (*Asellia tridens*), Pale Hedgehog (*Paraechinus micropus*).

**12 Less Pronounced Monsoon Influence.** Some winter showers with frost regularly occurring and rather dry hot summers, more akin to Mediterranean climate. Typified by Salt Range, Kala Chitta Hills and the eastern or outer hills of Waziristan. Most of these regions are heavily over-grazed showing only a degraded vegetation.

**Plants:** *Acacia modesta*, *Olea cuspidata*, occasionally *Tecomella undulata*, and on dryer slopes *Dodonea viscosa*, *Monothea buxifolia*, *Eryngium billardieri*, *Adhatoda vasica*, *Withania coagulans*.

**Mammals:** Urial (*Ovis orientalis*), Chinkara (*Gazella gazella*), Panther (*Panthera pardus*), Desert Fox (*Vulpes vulpes pusilla*), Desert Hare (*Lepus nigricollis dayanus*), Porcupine (*Hystrix indica*), Hyaena (*Hyaena hyaena*), Pangolin (*Manis crassicaudata*), Larger Rat-tailed Bat (*Rhinopoma microphyllum*), Bi-coloured Leaf-nosed Bat (*Hipposideros fulvus*), Caracal (*Felis caracal*), Soft-furred Field Rat (*Millardia meltada*), Brandt's Lesser Lowland Hedgehog (*Paraechinus hypomelas blanfordi*).

**13 Baluchistan Desert Scrub.** Usually associated with higher hills, stony plateaus or penepains. Very cold winters and no monsoon influence but occasional winter and spring showers. Typified by Northern Kalat, the lower parts of the Suleiman Hills, most of the Baluchistan valleys, the Kurram Valley and most of Waziristan and the North West Frontier Province. All these regions tend to be heavily over-grazed and felled and with vegetation degraded.

**Plants:** *Reptonia buxifolia*, *Haloxylon ammodendron*, *Pistacia interregima*, *Olea cuspidata*, *Nannorrhops ritchieana*, *Bromus molle*, *Bromus tectorum* and other *Bromus* spp. In Waziristan inner hill ranges the dominant species are *Quercus ilex*, *Olea cuspidata*, *Sophora mollis* and especially *Monothea buxifolia*. In ravines and valleys *Adhatoda vasica* and *Withania coagulans*.

**Mammals:** Hill Fox (*Vulpes vulpes griffithi*), Baluchistan race of Black Bear (*Selenarctos thibetanus gedrosianus*), Hyaena (*Hyaena hyaena*), Marbled Pole Cat (*Vormela peregusna*), Leopard (*Panthera pardus*), Caracal Cat (*Felis caracal*), Urial (*Ovis orientalis*), Goitered Gazelle (*Gazella subgutturosa*), Cape or Tibetan Hare (*Lepus capensis*), Porcupine (*Hystrix indica*), Libyan Jird (*Meriones libycus*), Sundeval's Jird (*Meriones crassus*), Baluchistan Gerbil (*Gerbillus nanus*), Migratory Hamster (*Cricetulus migratorius*), Brandt's Greater Hedgehog (*Paraechinus hypomelas*), Greater Horse-shoe Bat (*Rhinolophus ferrum-equinum*).

## G. TROPICAL THORN FOREST

14 *Indus Plains*. Principal edaphic feature is deep soil. Most of this region has been cleared for cultivation and last remnants of forest are heavily degraded due to over-grazing and felling by charcoal burners. Limited areas of small sandhills are usually interspersed with flat 'patts' and some of these areas are highly saline. Typical areas may be found between Jhang and Shorkot Road, around Kasur on the border of India and in Sind on the right bank of the Indus around Kashmir.

*Plants:* *Prosopis spicigera*, *Tamarix aphylla*, *Capparis decidua* and *Salvadora oleoides* with understorey of *Suaeda fruticosa* and *Chenopodium album*. In the south *Salvadora oleoides* is replaced by *Salvadora persica*.

*Mammals:* Jungle Cat (*Felis chaus*), Wild Pig (*Sus scrofa*), Desert Wolf (*Canis lupus pallipes*), Common Grey Mongoose (*Herpestes edwardsi*), Long-eared Hedgehog (*Hemiechinus auritus*), Desert Jird (*Meriones hurrianae*), Yellow-bellied Scotophil Bat (*Scotophilus beathi*), Kuhl's Pipistrelle (*Pipistrellus kuhli*).

15 *Sand-dunes*. Extensive areas of undulating sand-dunes often associated with absence of cultivation and extensive semidesert — typified by Thal Desert, Cholistan and Thar Desert.

*Plants:* *Calligonum polygonoides*, *Albahi camelorum*, *Acacia jacquemontii*, *Prosopis spicigera*, *Pennisetum dichotomum*, *Leptadaenia spartium*, *Capparis decidua*, *Tamarix articulata* and *Eragrostis tef*. In the sand-dune areas of Nushki and Chagai instead of *Calligonum polygonoides* binding the sandhills together, the dominant bush is *Haloxylon ammodendron*.

*Mammals:* Desert Fox (*Vulpes vulpes pusilla*), Small Indian Civet (*Viverricula indica*), Caracal Cat (*Felis caracal*), Hairy-footed Gerbil (*Gerbillus gleadowi*), Cheesman's Gerbil (*Gerbillus cheesmani*), Common Indian Gerbil (*Tatera indica*), Chinkara (*Gazella gazella*), Kutch Sheath-tailed Bat (*Taphozous kachensis*), Desert Hare (*Lepus nigricollis dayanus*).

## H. RIVERAIN PLAIN OR INDUS BASIN

16 *Inundation Zones, Seepage Zones, Jheels and Swamps*. These include areas subject to summer flooding but which often become dry by April or May. There are very few areas of permanent swamp in Pakistan. Typical examples are around the East Nara and Sanghar, Ghauspur in Jacobabad District and Manchar in Dadu District — all in Sind, Trimmu and Balloki Headworks in the Punjab, and Lal Suhanra near Bahawalpur.

*Plants:* *Saccharum spontaneum*, *Phragmites communis*, *Tamarix dioica*, *Typha elephantina*, *Typha angustata*, *Arundo donax*, *Paspalum ditichum*, *Erianthus* spp.

*Mammals:* Wild Pig (*Sus scrofa*), Hog Deer (*Axis porcinus*), Smooth-coated Indian Otter (*Lutra perspicillata*), Fishing Cat (*Felis viverrina*), Yellow-bellied Scotophil Bat (*Scotophilus beathi*).

17 *Riverine Tract*. The immediate vicinity of the Indus River and its tributaries up to the base of the foothills in the north.

*Plants:* *Tamarix dioica*, *Tamarix aphylla*, *Saccharum spontaneum*, *Populus euphratica*, *Acacia arabica*.

*Mammals:* Smooth-coated Indian Otter (*Lutra perspicillata*), Hog Deer (*Axis porcinus*), Wild Pig (*Sus scrofa*), Small Indian Civet (*Viverricula indica*), Short-tailed Mole Rat (*Nesokia indica*), Jungle Cat (*Felis chaus*), Jackal (*Canis aureus*), Desert Hare (*Lepus nigricollis dayanus*).

18 *Littoral or Inter-tidal Zone*. Typified by Indus mouth and Sonmiani and other bays along the Mekran Coast, being characterized by mangroves.

*Plants:* *Avicennia officinalis*, *Rhizophora conjugata*, *Ceriops tagal* and *Salsola foetida*.

*Mammals:* Lesser Bandicoot Rat (*Bandicota bengalensis*), Hog Deer (*Axis porcinus*), Smooth-coated Indian Otter (*Lutra perspicillata*), Fishing Cat (*Felis viverrina*), Plumbeous Dolphin (*Sotalia plumbea*), and Finless Black Porpoise (*Neomeris phocaenoides*).

## Niches

Even such a detailed breakdown into 18 more or less ecologically distinct habitats cannot accurately portray the actual distribution or occurrence of mammals. This is because each animal species occupies a particular position or ecological niche (Farb, 1965 and Elton, 1966) in relation to other animal and plant species in its environment, which may restrict the extent of its movement within any one habitat. Thus, for example, in the conifer forests of the Murree Hills the niche of burrower and underground root feeder is occupied by the vole *Hyperacrius wyneii*, while the niche of feeding amongst rotting leaf litter is occupied in the case of small food items by the Long-tailed Field Mouse and for larger particles by the Indian Porcupine. On the other hand in the Murree Hills there is no rodent species especially adapted to finding its food in the shrub layer of the forest but in similar forest in the Hazara district for example we find this niche occupied by the Chinese Birch Mouse. Two other species of rodent (*Petaurista* and *Hylopetes*) live and find their food in the treetops, and even the air around them provides the principal feeding territories of such species as the Grey Long-eared Bat (*Plecotus austriacus*) and the Greater Horseshoe Bat (*Rhinolophus ferrum-equinum*). Similar examples could of course be quoted for other habitats but for these the reader will need to turn to accounts of the species themselves later on in the book.

One of the important effects of a species becoming adapted to fill a particular niche in the environment is that it cannot disperse readily through other habitats in which no suitable niches occur. Thus various rodent species adapted to burrowing in soft sand have spread as far from north Africa as Baluchistan but have been unable to cross the high plateau of central Baluchistan. Many species have undoubtedly become extinct because they were unable to adapt to their changing environment. Others such as the Persian Wild Goat (*Capra bircus*) and the Markhor (*Capra falconeri*) survive only because their chief predator, man, has been unable effectively to penetrate some of their last strongholds in mountainous regions with extensive precipitous cliffs.



### 3 ECOLOGICAL ADAPTATION WITH SPECIAL REFERENCE TO DESERT SURVIVAL

#### General Behaviour

Many animals are able to avoid harsh climatic conditions such as extremes of heat, cold and dryness by adapting their behaviour in such a way that they spend most, if not all, of their time in more equable conditions. Thus, most desert rodents spend the daytime in burrows which provide relatively cool and humid environments (see, for example, Schmidt-Nielsen, 1950) compared with the surface. They come out to forage only at night when the surface temperature drops. In addition, when inside their burrows animals such as the Indian Brown Spiny Mouse and the Five-toed Jerboas plug up their burrow entrances, and this also helps to conserve moisture. In Pakistan many non-rodents, some of which are quite large, also dig and occupy burrows. They include the two cats, *Felis libyca* and *Felis margarita*, the Hyaena, Wolf, Ratel and the Pangolin. Other large animals such as the Urial Sheep, may simply rest in the shade during the heat of the day.

#### Area to Volume Ratio

Large animals have a relatively smaller surface area compared with their bulk than do small animals and therefore tend to be more efficient at conserving heat. Thus, large animals have an advantage in cold climates and small animals in hot ones. This may explain why adult specimens of the Markhor from cold northern Gilgit, *Capra falconeri falconeri*, stand up to 10 in. higher at the shoulder than do those of the subspecies *Capra falconeri jerdoni* from the extreme south of its range in Baluchistan.

Some small animals have increased their heat-radiating surface area by developing greatly enlarged ears which are copiously supplied with small blood vessels. Compared to other hare species inhabiting cooler climates, both hare species (*Lepus capensis* and *Lepus nigricollis*) found in Pakistan have especially wide and large ears, and the Persian Jerboa also has long upright almost hare-like ears. The heat dispersing ability of the large ears of the desert dwelling Rüppell's Fox (*Vulpes rüppelli*) is further improved by having a pale dorsal surface. It seems probable that the desert hare which spends the hottest part of the day resting on the ground surface, may be capable of absorbing heat by an increase in body temperature which can be dissipated during the cool desert night by radiation and conduction from the broad surface area of its ears.

#### Pelage

Mammals which live at high altitude and have to withstand prolonged periods of low temperature develop a dense undercoat of wool-like hairs which interlock and trap layers of insulating air beneath the protective outer layer of guard hairs. Such mammals cannot tolerate warm temperatures and are typified by the Himalayan Ibex (*Capra ibex sibirica*) and the mountain race of the Red Fox (*Vulpes vulpes montana*). They shed most of their underwool during the spring moult but in early summer can avoid high temperatures by seeking shade or higher altitudes. Mammals that cope with wide day and night temperature fluctuations do not develop

a thick underwool which would prevent heat dispersal during the day. Thus, the Urial and Markhor develop body hair which is rather thick and wiry, almost pithy in texture. Both species have very little underwool in winter and none after the summer moult. Such a pelage is not easily cracked or parted by strong winds with a subsequent loss of the insulation. This type of hair allows more efficient evaporative cooling under its surface during the heat of the day and at the same time it can support a steeper thermal gradient. The stiff spiny hair of the Urial stands out well from the body and is cushion-like to the touch. Studies on the camel have revealed that its fur has very high insulating properties. Lying resting in the sun, a summer temperature of 70°C (160°F) has been measured on the surface of its fur whilst the temperature on its skin under the hair recorded only 40°C (104°F) (Schmidt-Nielsen, 1964). The Chinkara Gazelle and the camel both have very glossy shiny hair in summer which probably aids in reflecting the sun's rays and minimizing the effects of solar radiation. It is significant that *Gazella subgutturosa*, which normally lives in high, cool altitudes, does not develop a similar glossy pelage. The fur of the Urial is also dull and not glossy in winter as observed from captive specimens.

#### Fat Distribution

It is well known that all mammals have the ability to store surplus food energy in the form of fat whenever their energy requirements for normal activity are less than what is available from their food. Fat is a very effective heat insulator. In many arctic mammals a subcutaneous layer of fat is the principal mode of providing insulation. The seals provide such an example. Mammals that live in hot desert conditions may store fat for different reasons. In the first instance it is noteworthy that they tend to accumulate fat in a localized and generally distal portion of the body surface. Thus heat loss, essential for survival, is not inhibited over the rest of the body. Besides the fat-tailed sheep of the steppe regions of Baluchistan and the North West Frontier Province, the desert adapted mouse-tailed Bats (*Rhinopoma*) and Sheath-tailed Bats (*Taphozous*), which store fat in the lower pelvic region, may be cited. These fat deposits accumulate noticeably at the end of the monsoon season. I have found *Rhinopoma microphyllum* in the southwest Punjab, roosting under a corrugated iron roof in June in a region where the temperature must have been at least 43°C (110°F). The tiny Pigmy Jerboa (*Salpingotus michaelis*) also stores fat in the proximal portion of its tail. Fat storage in these species may serve a physiological role as a water store since such fat deposits often accumulate just before prolonged dry seasons. 106 parts of water can be obtained from 100 parts of fat by oxidation (Ghosh and Purohit, 1964). Fat accumulation and storage is not essential to survival even in desert regions for mammals which can obtain a fairly constant food supply. Thus *Gerbillus cheesmani* which is sympatric with *Salpingotus*, in south western Baluchistan, does not exhibit fat storage.

#### Heat Tolerance

Studies on the camel showed that it has a fairly wide tolerance to hyperthermia (Schmidt-Nielsen et al., 1967). Its body



can store heat accumulated during the daytime, as it has a high thermal inertia. Its body temperature may rise as much as 70°C during a summer day, yet its normal physical body processes are not unduly accelerated as would be the case with more temperature sensitive animals. The camel is capable of losing this stored heat during the cool of the night. My own observation on captive specimens in the summer temperatures of the Punjab plains indicate that *Gazella gazella* and *Gazella subgutturosa* will lie down to rest in the most exposed sunny situations without apparent discomfort. The Urial, by contrast, will seek shade. In their natural habitat the Urial can easily find shade under some overhanging rock or bush whereas both gazelle species inhabit open terrain devoid of shade. It seems highly probable, therefore, that gazelles like camels have a wide tolerance to hyperthermia and can tolerate a daily rise in body temperature without harm. It has also been recently demonstrated (Baker and Hatward, 1968) that smaller ungulates such as gazelles have a special coolant device in the arrangement of the carotid arterial system passing through a venous pool in the cavernous sinus of the nose. This pool is cooled by evaporation from the walls of the nasal passages and in turn absorbs heat from the carotid rete.

### Hibernation and Aestivation

Mammals have methods of coping with seasons or periods of extreme adversity. They go into a prolonged sleep which is termed hibernation in winter or aestivation in the summer. The actual physiology of hibernation or aestivation is still imperfectly understood. It seems to occur in varying intensities. The Forest Dormouse (*Dryomys nitedula*) and the Long-tailed Marmot (*Marmota caudata*) are able to slow metabolic processes to such an extent that their body temperature drops to below freezing and is similar to the ambient. The pulse can hardly be measured it is so faint, and these animals, when handled and even warmed up, do not wake for several hours. Mammals such as bats and hedgehogs, which seem capable of entering a state of torpidity at almost any season, remain partly awake, or sufficiently conscious, to be able to react quickly to any disturbance. Nearly all mammals which are capable of true prolonged hibernation store up considerable reserves of fat beforehand. Fat reabsorption presumably goes on gradually during hibernation. Even during short periods of aestivation, it has been observed that respiration in hedgehogs is abnormally slow and shallow and that the heart rate slows. The body temperature usually remains within one to two degrees of the ambient temperature. Baluchistan has a very cold and severe winter and offers many examples of mammals which partially hibernate, such as the Forest Dormouse (*Dryomys nitedula*), the Persian Jird (*Meriones persicus*), the Migratory Hamster (*Cricetulus migratorius*) and the Afghan Hedgehog (*Hemiechinus megalotis*). During hibernation all these mammals wake up periodically and may emerge to forage briefly or perhaps only move around within their nesting burrow. Hedgehogs in Baluchistan also undergo periods of aestivation in the summer. During the early spring, when certain insects and other invertebrates are plentiful, they rapidly build up a subcutaneous layer of fat. Even tropical bat species not known to hibernate, like the Yellow-bellied Scotophil (*Scotophilus heathi*) accumulate fat by the end of the monsoon season and remain in their diurnal roosts for prolonged periods in the early autumn and intermittently throughout the winter in the Punjab.

By contrast there are examples of mammals living in equally cold surroundings which do not hibernate. The Quetta

Mole Vole (*Ellobius fuscocapillus*) which can subsist on underground roots and bulbs all the year round is one such example. The Collared Pika (*Ochotona rufescens*) also stores surplus green food underground and actually dries cut pieces of fodder before dragging them into its burrow. It therefore does not hibernate. In the far northern mountainous regions, snow covers the ground most of the year. The Marmot (*Marmota caudata*) hibernates until most of the snow has melted, but the Mountain Vole (*Alticola roylei*) of the same region continues to feed throughout the winter, on grass roots and remains relatively well protected from low temperatures by tunnelling under the snow. In Pakistan both the Black and Brown Bears (*Selenarctos thibetanus* and *Ursus arctos*) may hibernate, though in the case of the Black Bear this is a much less profound sleep and they occasionally wake up and emerge during the winter.

As already indicated, some mammals exhibit comparatively short periods of torpidity or inactivity. Bats, during such periods, remain all night in their roosts, yet when they are approached they are often alert enough to see the intruder and escape. A captive Long-eared Hedgehog in the possession of the author, once went 28 days without eating any food yet it did not sleep permanently and, if handled gave evidence of being very much awake. There is another curious phenomenon exhibited by some desert rodents known as 'facultative hypothermia'. Certain rodents in autumn and early winter become quite torpid by day and no amount of handling will rouse them. Yet at night, when the temperature drops, they again become active and normal. There is thus, a daily cycle of torpidity followed by intense activity at night. It has been observed in some North American rodents (Tucker, 1962 and 1966) as well as in the Persian Brush-footed Jerboa (*Jaculus blanfordi*) and the Pigmy Jerboa (*Salpingotus michaelis*) also. This behaviour is, however, always connected with seasons of great food scarcity.

### Evaporative Cooling

Evaporative cooling requires a lot of water and is too extravagant a method for desert species unless they have access to free drinking water. Evaporative cooling is most effectively done through sweat glands but these glands are severely limited (in body area) amongst arid zone mammals. The camel, for example, has sweat glands concentrated only in the rear of the neck and axillary regions of the limbs. Small mammals usually do not possess sweat glands. They cannot afford to lose body moisture so rapidly. Their size results in a much less favourable volume to surface ratio and they could not effectively reduce high temperatures as can larger angular mammals, and if unable to retreat into cooler burrows they do in fact die from hyperthermia. Evaporation can also occur by transpiration of moisture from the lungs. Shallow frequent respiration increases evaporation. The panting of a dog is the most familiar example of this method of cooling. Hares which rest on the surface during the heat of the day can increase their respiration rate by 4 to 5 times normal and this helps to dissipate body heat. In early spring before the winter fur has moulted, panting can be observed during the resting period throughout the heat of the day, by the Indian Gazelle (*Gazella gazella*) and the Urial sheep (*Ovis orientalis*).

### Dehydration Tolerance

Larger mammals like the ungulates can withstand the problems created by excessive moisture loss by an increased ability to replenish lost body fluids as compared with other

mammals, coupled with an ability to withstand such loss without harming essential metabolic processes (Schmidt-Nielson, 1952). Detailed studies of the physiological reactions of mammals to heat stress and desiccation have mainly been carried out on domestic animals. Presumably wild representatives of desert dwelling ungulates are not so easy to study. We may compare, however, the results of studies on the domesticated donkey with the very closely related Indian Wild Ass which occurs in the Rann of Kutch. It can withstand a loss of up to 25 per cent of body weight through evaporative losses and still suffer no permanent harm nor any loss of appetite. By drinking, it can replenish this entire loss in a matter of minutes (Schmidt-Nielson, 1964). Studies of *Ovis canadensis* in the extreme southern part of its range in the hot desert conditions of New Mexico have revealed the same ability to withstand water loss and to replenish it by drinking astonishing quantities of water — up to 25 per cent of the animal's total body weight in one draught (Schaller, pers. comm.). It would be reasonable to assume that races of the Urial living in Baluchistan have similar adaptive abilities. Man, by contrast, loses his appetite and cannot eat once his body fluids have dropped below a certain point. Furthermore if he drinks too much, too rapidly, he cannot reabsorb this fluid and dies of toxæmia resulting from too rapid a dilution of blood and tissues. Large desert mammals, such as Gazelles and the Wild Ass have great endurance and can travel up to 30 miles in one day to reach water for drinking. Even in the hot dry season of early summer when free water is needed, such mammals can obtain enough if they visit springs or drinking pools after six or seven day intervals. During the monsoon period and early winter there is often sufficient moisture from dew to meet the needs of large mammals. These animals feed at first light in the early morning as well as the late evening when condensation of moisture is at its maximum.

Desert mammals also conserve water by producing urine which has an unusually high concentration of urea. In the Jerboa it has been found that the concentration reached 23 per cent (compared with 11 per cent urea in man's urine) (Bartholomew, 1963). On a moist or wet diet the urine of Jerboas becomes more alkaline with less concentration of urea (Happold, 1967). Furthermore, the faeces of desert rodents, Pikas and wild goat species have a very low moisture content. Many rodents are able to feed on Halophytic plants and utilize the water contained in their succulent leaves. From numerous scientific experiments (Ghosh and Gaur, 1966; Ghosh and Purohit, 1964; and Schmidt-Nielson, 1964), it would appear that such rodents as *Tatera indica* and *Gerbillus gleadowi* have exceptional renal concentrating ability and must be able to produce urine with a very high salt content. Rodent species such as *Rhombomys opimus*, *Millardia gleadowi* and *Allactaga elater* have been found in areas where halophytic plants appear to be their principal food and they can often be found in considerable numbers in regions devoid of other mammalian life. The water requirements of small mammals have to be met from vegetation, seeds and insects, since they have a relatively restricted range and most species in the desert cannot have access to free water. But because they do not possess sweat glands and use minimal quantities of water for excretion they are able to produce a net excess of water supply during the normal metabolic process. In fact Gerbils adapted to desert environments can maintain body weight and health for indefinite periods on a diet of only seeds, without imbibing any free-water (Happold, 1967) or even succulent vegetation. Larger ungulates such as the Wild Goat can survive for considerable

periods without drinking free water, utilizing the moisture contained in succulent vegetation but may need to drink in seasons when succulent vegetation is scarce.

### Finding and Utilizing Food

Many insectivorous mammals have the ability to hibernate or aestivate, yet the abundance of insect life during favourable seasons even in semidesert regions encourages insectivorous mammals to colonize such areas. It is probably no coincidence, therefore, that in the whole Indian subcontinent the greatest number of species and population of hedgehogs occur in desert regions. An insect diet is relatively high in water content and therefore the problem of water conservation is much less severe for insectivorous mammals in desert areas than it is for graminivorous mammals. However, just as many plants tend to develop unpleasant resins or thorns, so many desert arthropods and other invertebrates become obnoxious to predators through poisonous glands or offensive smell (Brown, 1970). The dry regions of Pakistan are rich in decapods, such as the poisonous scorpions, also Solifugid spiders, Tenebrionid beetles and Velvet mites. At least seven different species of scorpion belonging to three genera have been collected in Baluchistan (Dr. H. A. Qadri, pers. comm.). Velvet mites have a toxic secretion. Tenebrionid beetles often have an offensive smell. The Black Widow spider (*Latrodectus hasseltii*) is highly venomous, and is common in Sind and Baluchistan. Both hedgehogs and mongooses seem to be immune to these poisons and stings and will deliberately hunt and eat scorpions as well as poisonous spiders, stinging Hymenoptera, etc. There are several highly venomous snake species common in the plains, as well as warmer mountain regions. The Saw-scaled Viper (*Echis carinatus*) is one of the most common snakes of dry rocky areas in Sind and Punjab and the Leaf-nosed Sand Viper (*Eristicophis mcmaboni*) is plentiful in southern Baluchistan. Desert Cats (*Felis libyca*) and Jungle Cats (*Felis chaus*) have become adept at overcoming and killing these venomous snakes without injury to themselves (see the account of the Jungle Cat, p. 140). Hedgehogs will also overcome and eat small snakes, rolling themselves into a ball after grabbing the lower part of the snake's body so that the snake strikes in vain against the Hedgehog's spines. The hedgehog in its turn is an important source of food for desert carnivores, despite its protective armour of spines. The Rock-horned Owl (*Bubo bubo turcomanus*), which hunts at night and is widespread in Baluchistan, is especially fond of hedgehogs, though it is not understood how it succeeds in overcoming the animal. Jackals (*Canis aureus*) and Foxes (*Vulpes* spp.) are also able to turn hedgehogs over on their backs and to kill them without injuring themselves.

### Plant Food

Desert mammals have developed an ability to utilize very coarse and low value plant food. The Wild Goat species of Baluchistan and the drier inner Himalayan ranges are able to browse on thorny plants and can eat the Camel Thorn, *Albahi camelorum* and even some *Astragalus* species both of which are largely shunned by domestic sheep flocks. Other mammals, *Nesokia indica*, *Ellobius fuscocapillus* and *Hystrix indica* have managed to find a food supply in the steppe region by burrowing and feeding on the rhizomes and bulbs. In smaller rodents with herbivorous diet the teeth are not



high crowned, as in the larger ungulates, but open rooted and continue to grow throughout the animal's life so that the worn surface is replaced by growth from underneath. The High-mountain Vole (*Alticola roylei*) as well as the Quetta Mole Vole (*Ellobius fuscocapillus*) and even the Giant Jird (*Rhombomys opimus*) all have rootless continuously growing molars. The Jerboa (*Jaculus blanfordi*) and the Grey Hamster (*Cricetulus migratorius*) found in western Kalat and Baluchistan are examples of largely graminivorous feeders. Their molar or grinding teeth are bunodont, i.e. their surface is tubercular to facilitate cracking hard seed pericarps.

Large hooved animals have an elaborate digestive system with an extensive caecum or lower intestine where bacterial fermentation and decomposition of the vegetative matter occurs. The stomach is often compartmentalized and after entering the first compartment food can be regurgitated later to be re-chewed and ground into finer particles. Camels, deer, goats, sheep and antelope all use this process of chewing the cud. This efficient digestive system may partly explain why so many large ungulates have been successful in colonizing semidesert regions. Lagomorphs (Hares and Pikas) do not have large compartmentalized stomachs but have a relatively extensive caecum (ten times the capacity of the stomach) which has the vital function of breaking down bulky vegetable matter with the aid of bacterial fermentation. (Walker et al., 1964). They also practise coprophagy or re-eating of partly digested food. In the early part of the night Lagomorphs produce large, rather damp, blackish faeces known as caecal faeces. They ingest this material and redigest it. During the latter part of the day smaller and greenish faeces are produced with a much higher dry-matter content. I have observed coprophagy in a captive Baluchistan Hare (*Lepus capensis*). It is believed that some rodents may also re-use their own caecal faeces, particularly some of the Vole species (*Microtinae*), though this has not been observed in Pakistan.

## Survival against Predators

### (a) Acute Senses

Having considered adaptations connected with obtaining food in semidesert regions we must also consider adaptations of those desert mammals which are potential food for larger predators. Many mammals rely upon acute perceptive senses followed by great speed in escaping. The larger ungulates possess remarkably keen eyesight, and though they lack binocular vision they probably have an excellent ability to discern movement. Any one who watches and stalks mountain game such as Urial (*Ovis orientalis*), Markhor (*Capra falconeri*) or Ibex (*Capra ibex*) will have noticed how intently these animals watch for danger before moving and how often they appear to be well aware of the human intruder long before they themselves are sighted. Their sense of smell is also acutely developed. These large hooved animals are largely diurnal in their feeding activity so that sight is sometimes more valuable than sound.

Smaller nocturnal mammals with a more limited field of vision must rely more heavily on acutely developed hearing. The tympanic bullae (the inflated mastoid chambers under the rear part of the skull), which act as resonators and sound amplifiers, are especially large in desert rodents compared with other species of more humid climates. Rodents of sand-dune areas have noticeably large tympanic bullae; for example the Jerboa (*Jaculus blanfordi*) and the Hairy-

footed Gerbil (*Gerbillus gleadowi*). It is probable that their hearing is so acute that they can detect the muted wing beats of owls which hunt them by night as well as the soft scraping approach of Sand Boas (*Eryx jobni*) and Vipers (*Echis carinatus*) which often hunt these rodents. Rodents living in soft sand-dunes also excavate side passages, which end a few centimetres below the ground surface. Such burrows are thus invisible to predators on the surface, but if their main entrance is entered, the occupant can quickly burst through to the surface from the alternative escape channels, e.g. *Allactaga elater*.

In predator/prey relationships in desert environments there is often an especially acute development of both visual and auditory acuity. In a very dry atmosphere sensitivity to vibrations and ability to detect movement are more important, perhaps than olfactory receptors which function better in a humid atmosphere.

### (b) Speed and Agility

Many desert dwelling mammals have also developed exceptional speed in running, such as the Chinkara Gazelle (*Gazella gazella*) which on open clay flats has been clocked against a vehicle at 45 mile/hr. I have estimated that the Desert Hare (*Lepus nigricollis*) is capable of a speed of 38 mile/hr for a distance of nearly two furlongs. In order to facilitate speed of locomotion many desert dwellers have long strides and accelerate to great speeds. The large and comparatively bulky muscles, which supply motive power, are confined to the upper parts of the limbs and the distal part of the leg is generally slender. Such a structure minimizes friction and is especially well developed in the gazelles. Some of the desert rodents have increased their speed through saltatorial locomotion. The hind feet are greatly elongated and the front feet employed only when feeding leisurely. Both *Gerbillus* and, to a greater extent, the Jerboas have evolved along these lines. The femur as well as the fibula and tibia are all greatly elongated and the large locomotor muscles are attached to the pelvic girdle. These little rodents are digitigrade (toes) rather than plantigrade like the Porcupine (*Hystrix indica*). In North Africa, Four-toed Jerboas (*Allactaga tetradactyla*), which are closely related to the species found in Baluchistan, have been clocked at 30 mile/hr (48 km/hr) leaping along in front of a car. This is a truly astonishing speed considering the small size of these Jerboas.

Psammophylic mammals have developed a character which must be of considerable value. Most large carnivorous mammals have naked toe and heel pads. The feet of the Rüppell's Fox (*Vulpes rüppelli*) and those of the Sand Cat (*Felis margarita*) are unique amongst all the canids and felids in having the pads entirely covered by long hair. Small rodents, on the other hand, have developed stiff fringes of long hairs framing the outer toes. This presumably gives their feet an ideal bearing surface on soft sand. *Salpingotus*, *Gerbillus* and *Jaculus* found in Pakistan, are all examples of this characteristic. In the case of the larger carnivores the hairy soles may also be a useful insulating device against the hot surface of the sand if they travel abroad during the daytime. Perhaps the furry soles also aid in presenting a better friction surface when moving at speed over soft sand. Rodents that live in stony, rocky areas generally have naked pads on the soles of the feet. Such a minute difference, for example, is one of the main distinctions between the mountain dwelling Persian Jird (*Meriones persicus*) and the valley dwelling Libyan Jird (*Meriones libycus*), otherwise almost identical in size and outward appearance.



### (c) Camouflage

Most desert mammals, especially the larger diurnal mammals have fur of a pale and uniform pattern which blends perfectly with their surroundings. Against a rocky background, the reddish-grey fur of the Urial or the Markhor is very difficult to pick out, and only mature males are conspicuously patterned. Desert carnivores, if they hunt by night, do not need to be so cryptically coloured but it is noteworthy that all the smaller cat species in these regions are a dull ochrous or reddish-buff colour, e.g. *Felis margarita*, *Felis libyca* and *Felis chaus*. Small cats from forest or swamp areas have much more conspicuous spotted or striped pelage. Smaller mammals can often escape detection by lying or standing motionless when cryptically coloured. The Desert Hare (*Lepus nigricollis dayanus*) often escapes detection by lying motionless. Desert rodents such as Gerbils, Jirds and Jerboas are all of a pale sandy-buff coloration in contrast to the darker, brighter pelage of rodents which feed underground such as *Nesokia indica*, or live in regions with thicker vegetative cover e.g. *Apodemus sylvaticus*.

### Reproduction

There is one aspect of reproductive behaviour which is particularly interesting in desert mammals and this relates to the methods of establishing contact between sexes. In the large, gregarious or social mammals where sight is also well developed, intra specific contact is maintained partly by olfactory means (pit glands in feet and inguinal region) and also by conspicuous body markings. The white stocking pattern of the legs of all three wild goat species inhabiting the dry rocky regions of Pakistan may well serve this function, as they are otherwise almost invisible against their rocky background. During rut the males are often easy to see at considerable distance because of body patterns not exhibited by females or younger males. The old Urial rams have conspicuous black and white chest ruffs and saddle marks. Himalayan Ibexes have pale silver saddle and rump patches, mature Markhor and Persian Wild Goats are a pale grey colour with contrasting black chests. Perhaps these bold patterns help the females to recognize males during rut, as the mature males of these gregarious species generally remain quite separate from the herd during the rest of the year.

Where food is scarce and a species population is widely dispersed it is even more necessary to have special devices for attracting the opposite sex and advertising the presence of a potential mate or rival. Wild sheep and gazelles have sub-orbital scent glands and the males constantly rub their foreheads on bushes and low projections during the rutting season. It is believed that scent from these face glands is deposited thereby on bushes. The male Musk Deer (*Moschus moschiferus*), though not a desert form, has a large scent gland which exudes the musk secretion only during the rutting season. These deer are quite untypical of the family *Cervidae* in that they never associate with other members of the same species except during rutting season. The Desert

Hare (*Lepus nigricollis dayanus*) has perineal glands which leave a scent where the animal has squatted. The Small Indian Civet (*Viverricula indica*) has anal scent glands in both sexes and they regularly rub these glands against stones, low branches, etc. Some of the antelopes have the habit of going to a particular spot to deposit their faeces and such accumulations may serve to mark territory and indicate their presence to other members of the same species. The Chinkara Gazelle (*Gazella gazella*), the Nilghai (*Boselaphus tragocamelus*) and to a lesser extent, the Black Buck (*Antilope cervicapra*) all exhibit this trait.

At the time of birth of the young animals, the risk from predators is at its highest. Carnivorous mammals produce relatively weak and slow developing young. Rodents also produce weak and helpless young, but many species can sustain a high rate of predation because of the ability to reproduce three or four times a year. The large ungulates, however, have problems in protecting their young. Wild sheep, goats and gazelles have a relatively long gestation period so that the young are born well developed and even within two or three hours of birth they are capable of running and jumping actively. Moreover, the young animal imprints itself on the mother within a few hours so that it will try to follow her under all circumstances and up to the point of exhaustion. A captive born Urial lamb was observed to spring right over its mother's back when approached by the first human being it had seen and when it was estimated to be hardly three hours old. A baby Persian Wild Goat which appeared to be hardly seven or eight days old, was observed following its mother when pursued by some men, even though it failed to jump up steep cliffs at the first attempt and repeatedly slipped backwards. Apparently despite such falls it did not receive any serious injuries and succeeded in following its mother.

It is possible to conclude from this discussion of ecological adaptations, that in the struggle for survival, the finding of sufficient food appears to have been successfully solved but protection and shelter from predators and particularly from man are much harder problems to overcome through the slow process of ecological adaptation. The larger mammals are the most vulnerable to man's predation and because of man's increasing numbers and improved hunting ability, aided by modern weapons and vehicles, it is hardly surprising that they are fast becoming extinct. Ecological adaptation is a very gradual process requiring many generations to effect minute changes and man's technology has given him an unfair advantage in the hunt.

We must also remember that contributions towards survival made by adaptations in one mammal species may not be so vital in another closely related mammal because the latter may have evolved other more efficient or effective means. There are plenty of exceptions to every rule. Thus not all mammals living in hot deserts have big ears and not all mammals are swift in flight. If a mammal is a predator rather than a prey species it is not always cryptically coloured and often exhibits much greater variation in form and appearance than is the case with other mammalian orders.

## 4 INSECTIVORA

The members of this relatively primitive mammalian Order are generally not highly specialized and are believed to resemble some of the original basic mammalian forms. Most of them are fairly small with long and narrow rather mobile snouts and a highly developed sense of smell. Most of them also have small eyes and weak eyesight. They all have five digits on the front and hind feet and are usually plantigrade in gait with the heel of the hind foot coming into contact with the ground. Neither the thumb nor the big toe is opposable but some species can climb trees quite well. Teeth are large in number, non-specialized and rooted. Usually the molars have pointed cusps (see Fig. 8) and the Order as a whole is fairly omnivorous in diet though as their name implies insects generally form the most important part of their food supply.

The Insectivores are represented in Pakistan by the two families *Erinaceidae* (hedgehogs) and *Soricidae* (shrews).

### FAMILY ERINACEIDAE – HEDGEHOGS, MOON RATS, GYMNURES

#### Key to the Family Erinaceidae in Pakistan

Body short and thickset with dorsal surface protected by stiff spines. Tail short and stumpy. Eight teeth on each side of lower jaw.

#### Key to the Pakistan Genera of *Hemiechinus* and *Paraechinus* (see Fig. 5).

No distinct parting of the spines on the forecrown:

Genus *Hemiechinus* Fitzinger, 1866.

Spines on forecrown divided by a longitudinal naked furrow (see Fig. 5A):

Genus *Paraechinus* Trouessart, 1879.

#### Genus *HEMIECHINUS* Fitzinger, 1866

#### Key to the Pakistan Species of *HEMIECHINUS*

- (i) Small size. Face lacking white hairs around ears and upper part of crown. Average head and body length

160mm in Pakistan population with spines black at extreme tip.

... *Hemiechinus auritus*

- (ii) Large size. Face with admixture of white hairs. Head and body 240–265mm in Pakistan population with spines white at extreme tip.

... *Hemiechinus megalotis*

### *HEMIECHINUS AURITUS*

*Hemiechinus auritus* Gmelin, 1770; Long-eared Hedgehog. Subspecies *Hemiechinus auritus collaris* Gray, 1830; Long-eared or Desert Hedgehog formerly known as Hardwicke's or Collared Hedgehog (see Illustration 1).

**Description:** The Long-eared Hedgehog, as the name implies, has very conspicuous ears which in Pakistan specimens measure from 32–38mm ( $1\frac{1}{4}$ – $1\frac{1}{2}$  in.) in length. This is roughly equal to the length of the hind foot. In Pakistan this is rather a small hedgehog, with comparatively long legs and a tendency towards melanism. The stumpy tail and belly is rather sparsely covered with black hairs and the face is covered with dark brown or greyish-black hair. As with all the hedgehogs the snout is long and pointed, terminating in two moist nostrils. The well-developed fore-feet have five digits armed with strong curved claws. Its claws are noticeably longer than those of *P. micropus*. The spines of this hedgehog are not particularly long and in adults average 17–19mm ( $\frac{1}{2}$ – $\frac{3}{4}$  in.). The general appearance of the spines is rather blackish and the individual spines are wholly black in their distal half in the Pakistan individuals (see Fig. 6). Very often the long ears remain folded back behind the spines on the crown even after the animal uncurls itself. Adults vary from 140–175mm ( $5\frac{1}{2}$ – $6\frac{7}{8}$  in.) in body length, and from 40–50g ( $1\frac{1}{3}$ – $1\frac{2}{3}$  oz) in body weight, much lighter than some of the larger northern palearctic species. The tail is generally about 23mm (0.89 in.) in length.

It is noteworthy that specimens of *Hemiechinus auritus* from Iraq and Arabia are much paler than the Pakistan specimens with creamy-white hair on the face and belly (Harrison, 1964). Also specimens from Afghanistan vary from light to dark and appear to be considerably bigger than typical Pakistan specimens (Niethammer, 1969). In Pakistan,



A



B

Fig. 5 Showing difference in arrangement of spines on forecrown of hedgehogs of genera *Paraechinus* and *Hemiechinus*.

A. *Paraechinus* Species with divided forecrown.  
B. *Hemiechinus* Species with no furrow on forecrown.



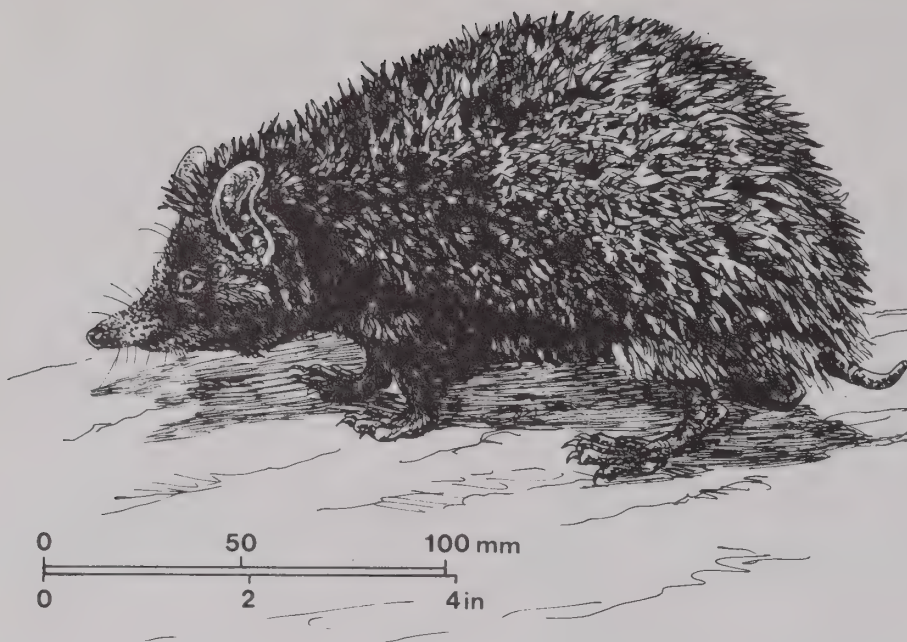


Illustration 1 *Hemiechinus auritus*: Long-eared or Collared Hedgehog. (Based on live captive specimen, adult female, Khanewal, Punjab.)

some individuals have a collar of white hairs extending from under the chin up to the ears, hence the name of Collared Hedgehog.

**Distribution and Status:** This is the commonest hedgehog species in Pakistan and the best adapted to xeric conditions. It is found throughout the Indus riverine plains and extends eastwards into the desert regions of Cholistan and Thar. It is specially plentiful in Bahawalpur and Southern Punjab in the irrigated tracts. It is absent from the mountainous regions to the west of the Indus and does not occur in the Himalayas or its foothill zone. In the southern region of Sind it is sympatric with the *P. micro-*

*pus*. It is however comparatively rare in the dryer hill regions of Thatta and Karachi Districts. In the Salt Range, and Kohat and Peshawar districts it is sympatric with *P. hypomelas*.

Outside of Pakistan this hedgehog extends throughout the lowland regions of Afghanistan (Niethammer, 1965) and the north eastern region of Iran (Lay, 1967) and most of the southern part of Asiatic Russia (Flint et al, 1965). It also extends to the eastern Mediterranean from Egypt through Cyprus, Israel and Iraq. Eastwards on the subcontinent it extends only into the Rajasthan and Kutch regions of India.

The Long-eared Hedgehog is beneficial to man as it consumes insects including termites and even scorpions.



Fig. 6 Showing difference in characteristic spinal pattern of Pakistan hedgehog species.

1. *Paraechinus micropus*. Note relatively smaller size and white tip.
2. (A) *Paraechinus hypomelas hypomelas*. Note dark tip with two basal bands.

- (B) *Paraechinus hypomelas blanfordi*. Note dark tip with basal portion also dark.
3. *Hemiechinus megalotis*. Note white tip.
4. *Hemiechinus auritus collaris*. Note distal portion entirely black with basal portion whitish.





Distribution Map 1 *Hemiechinus auritus collaris* Known distribution  
*Hemiechinus megalotis* Known distribution  
 Probable range

#### Distribution Map 1 Long-eared or Desert Hedgehog. Afghan Hedgehog.

Since it does not damage agricultural crops and lives largely in waste land on the edge of cultivation or in open desert it does not come into conflict with man.

**Biology:** The Long-eared Hedgehog escapes the intense heat of its desert habitat in summer by being strictly nocturnal in feeding activity, emerging at dusk when it feeds actively for five to six hours. When food is plentiful it returns to its burrow by about midnight and does not emerge again to forage until the following evening.

They are active diggers and excavate their own burrows. The burrow entrance is wholly or partly concealed under a shrub or a bush and if the ground is hard it may be quite short, extending no more than 1ft. In softer sandy soil the burrow may extend up to 5ft. The burrow terminates in a slightly wider chamber which is unlined and it is amazing how the Hedgehog, which descends head first into its burrow, is able to turn round inside a comparatively small chamber (Krishna and Prakash, 1955). Generally the burrow slopes down to about 1ft or 14in. below the surface and will be occupied by the same individual for the whole year.

They are unsocial creatures and never share a burrow system, with others of the same species.

Compared with the European Hedgehog this species is more active, and when it is out foraging its habitual mode of progression is by taking very rapid short steps. In feeding habits it is quite omnivorous and will seize and eat not only insect prey but batrachians, lizards, snakes and any small bird or mammal which they can overcome. The feeding habits of this species in the deserts of Rajasthan have been well studied (Krishna and Prakash, 1956 and 1960 and Prakash, 1959A). The Hedgehog appears to depend largely on scent to find its food and often snuffles with its snout in the roots of grass or leaf litter in search of insect larvae. They have been recorded as eating Spiny-tailed Lizards (*Uromastix* spp.), Sand Boas (*Eryx johni*), toads (*Bufo andersoni*)

and all sorts of Orthopterous insects (e.g. Mole crickets, Crickets and Grass-hoppers), also beetles, especially Dung Beetles (*Helicopriss bucephalus*). They are fond of birds' eggs and undoubtedly eat both eggs and nestlings of any ground nesting species they can find such as the Crested Lark (*Galerida cristata*) which frequents the same habitat. Cannibalism is also prevalent and females sometimes eat their own offspring and males will attack and eat any young hedgehogs they encounter (Prakash, 1955B and McCann, 1937).

Several authors have described the hedgehog's method of attacking dangerous prey (Herter, 1965, Krishna and Prakash, 1956). Venomous snakes may be seized anywhere on the body and the hedgehog, with spines erected and lowered head, keeps its face partially concealed so that the hapless reptile strikes in vain against the spines and injures itself. Often the hedgehog, if it seizes the tail of a snake or the limb of a large animal, will roll itself into a ball and commence chewing upon the seized portion. This method of feeding has been observed with a captive *Hemiechinus* (Mirza, 1969 and Krishna and Prakash, 1965). Several captive specimens kept by the author showed no interest in earthworms or snails which are eaten by the European Hedgehog. However they relished raw meat and cooked egg in any form. The Long-eared Hedgehog in Pakistan shows no interest in vegetable food nor even in ripe fruit in contrast to some other species such as *P. hypomelas*. Observations on captive specimens showed that they hardly chew any food very thoroughly, seeming to bolt it practically in whole mouthfuls.

It is only in recent years that records have been obtained of the breeding of hedgehogs in captivity. *Hemiechinus auritus* produced young in captivity 37 days after mating and the gestation period was found to vary between 35 and 42 days (Herter, 1965). It was earlier thought that the presence of spines would make mating difficult for hedgehog species, in the normal position of most mammals and that the female lay on her back. Observation on captive hedgehogs, however, has shown that the male copulates by standing almost vertically on his hind legs whilst the female lies with hind legs extended on the ground but on her ventrum. In Pakistan most litters are born during August and September at the height of the monsoon season when insect food is most abundant. The female produces her young in underground burrows. Observations on a captive Long-eared Hedgehog showed that a litter of four was delivered over a five hour period. The young were born with closed eyes and were completely naked except for rather sparse scattered spines which were 2mm ( $\frac{1}{16}$ in.) long, whitish in colour and quite soft. These new-born young averaged 8.325g ( $\frac{1}{4}$ oz) in weight and measured 47mm ( $1\frac{3}{4}$ in.) in length (Prakash, 1955A). Within about five hours of birth the spines had grown to about 8mm ( $\frac{5}{16}$ in.) in length and were beginning to darken in colour but were still soft. When the baby hedgehogs are about five days old numerous additional pigmented spines were visible sprouting over the skin and by the time they were two weeks of age their back was thickly covered with spines. Newly born young seem to locate their mother by smell. Suckling takes place with the mother lying on her side and the babies have been observed kneading the mother's breasts with their forefeet and sucking audibly. The young do not leave the nest burrow until they are four weeks of age after which time they accompany the mother on foraging trips. Studies in Rajasthan showed that litter sizes vary from 1 to 4 with 2–3 being more usual (Prakash 1960A). It is not known at what age the young hedgehogs become independent of their mother but this is probably at about

6–7 weeks. A young hedgehog picked up by me in late November was about half adult size when encountered foraging on its own and appeared to be about two months old.

Prater in his book of Indian Animals (1965) states that no hedgehogs in India and Pakistan are known to hibernate except the Afghan Hedgehog *Hemiechinus megalotis*. However studies in the 1950s by Krishna and Prakash revealed that the Long-eared Hedgehog in Rajasthan does hibernate in winter and does not emerge until early March (Krishna and Prakash, 1955). A specimen kept by the author after capture in late October, excavated its own burrow under some leaf mould on 8 November. This was in an open enclosure in the south west Punjab, in the same region (climatically) where it had been picked up. On 2 March it emerged from hibernation, at which time it appeared quite active and in no way weakened by its long fast. It is noteworthy that some captive Baluchistan Tortoises (*Testudo horsfieldi*) also emerged from hibernation on the same date. The occasional individual may be observed foraging even up to early December and no doubt in the warmer latitudes of Sind there is no prolonged hibernation of the species whereas in the Punjab it may hibernate for up to 3½ months. Towards the end of the monsoon season Long-eared Hedgehogs seem particularly abundant and can be seen in considerable numbers by anyone motoring at night along less frequented roads. A captive specimen kept accidentally without food or water in the laboratory even during the summer season survived without any apparent deterioration in health for ten weeks (Krishna and Prakash, 1956).

The Long-eared Hedgehog appears to have many natural enemies despite its prickly armour of spines. There are accounts of the Grey Mongoose (*H. edwardsi*) attacking and killing a hedgehog and their remains have been found in the stomachs of jackals and foxes. I have heard from nomadic hunting tribes (Jogis) that the jackal induces the hedgehog to uncurl itself by urinating upon it whereupon it seizes the hedgehog's vulnerable face. It is significant that the Common Fox in Europe has the reputation of tackling *Erinaceus europus* in the same way (Herter, 1965). I do not know whether this belief is based on any direct evidence and probably both foxes and jackals are quick enough to be able to knock a hedgehog over with a fore-paw and nip it in the vulnerable under-parts before it can curl up.

All hedgehogs suffer greatly from infestation by ticks (*Ixodes* spp.) but nothing has been recorded about internal parasites in the Long-eared Hedgehog. A captive Long-eared Hedgehog from Cyprus lived for three years and three months (Crandall, 1964).

The Long-eared Hedgehog exhibits a peculiar habit which has also often been recorded in the European species (*E. europus*). This habit has been described as self-anointing. The animal starts by chewing on some vegetable matter, generally grass roots and this results in copious frothy salivation. It then contorts itself so that its muzzle is twisted round to its back and flanks and the liquid vegetable paste or the saliva is plastered over the body. To some extent the hedgehog is able to part its spines so that the saliva is plastered onto the naked skin without injury to the animal's tongue. Professor Herter (1965) in his observations of captive hedgehogs noted that this process of self-anointing was usually triggered off by some strong smell stimulus. Most experts consider that the significance of this operation has yet to be understood. It seems possible that anointing may be a way of grooming otherwise inaccessible skin or helping to remove dried skin since the paste ultimately dries and cakes off. K. R. Eates (1968) gives a graphic account of two young

Long-eared Hedgehogs anointing themselves after chewing upon Dhoob Grass (*Eragrotis* spp.).

Long-eared Hedgehogs are relatively silent animals and the only vocalization recorded is a snake-like hiss which they emit when disturbed in their burrow or threatened by some predator. This hiss is generally accompanied by a sudden upward jerking of the body which can be a painful experience for the unwary predator.

## HEMIECHINUS MEGALOTIS

*Hemiechinus megalotis* Blyth, 1845; Afghan Hedgehog (see Illustration 2).

**Taxonomy:** This hedgehog was originally described from Kandahar by Edward Blyth, hence the name Afghan Hedgehog. The Khorasan Hedgehog which was described from the south western region of Trans-Caspia in Russia by M. K. Laptev is generally considered conspecific with *H. megalotis* (Ellerman and Morrison-Scott, 1951). Some Russian authorities still consider *Erinaceus* as the only valid Genus but distinguish *E. auritus* from *E. megalotis* (Bobrinskii et al., 1965). J. Niethammer in his studies of the Afghan Hedgehog noted that *H. auritus* intergraded with *H. megalotis* both as to size and other external diagnostic characters (Niethammer, 1969A). It is noteworthy that J. Hassinger in his introduction to the mammals of Afghanistan considers all the *Hemiechinus* population as belonging to *H. auritus* (Hassinger, 1968). However, since *H. auritus* from Pakistan is readily separable from *H. megalotis* with respect to size and coloration, I have continued to follow Ellerman and Morrison-Scott (1951) in their checklist by treating the latter as a separate species, although I believe that further investigation might indicate that *H. auritus* is really made up of three subspecies: *H. auritus collaris* in Indo-Pakistan regions; *H. auritus megalotis* in Afghanistan and north eastern Iran; and *H. auritus aegyptius* in North Africa and the Middle East.

**Description:** In Pakistan this hedgehog is much larger than *H. auritus*, adult specimens commonly reaching 270mm in length. Only *P. hypomelas hypomelas* reaches equal size in Pakistan and this latter species can be readily separated on the basis of colour plus the median naked groove on the fore-crown. The ears are quite long and conspicuous. Dimensions of eleven specimens from Pakistan were as follows: Head and body length averaging 251mm (range 230–278mm) with the tail averaging 33mm (range 22–55mm), the hind foot averaging 41mm (range 30–55mm) and ear averaging 47.5mm (range 38–60mm). Its tail is well clothed with hairs and is more conspicuous than the tail of *H. auritus* occurring at lower and warmer altitudes. This hedgehog has much longer spines than *H. auritus* and if examined closely they will be seen to bear three dark bands with only the external tip being whitish-horn coloured (see Fig. 6). The spines on the lower back and flanks commonly reach 34mm (1½ in.) in length. The population of this hedgehog in Pakistan tends to be rather rufous in coloration. It would be an exaggeration to call them erythristic, but nevertheless the hair covering the limbs, ventrum and tail as well as the lower part of the head are noticeably reddish-brown or auburn in colour. The upper part of the face and particularly inside the ears and the top of the crown has a considerable admixture of white hairs often imparting a rusty colour. Because of the extensive brown tips to the spines and their extra length, the entire body of this hedgehog tends to look dark reddish brown



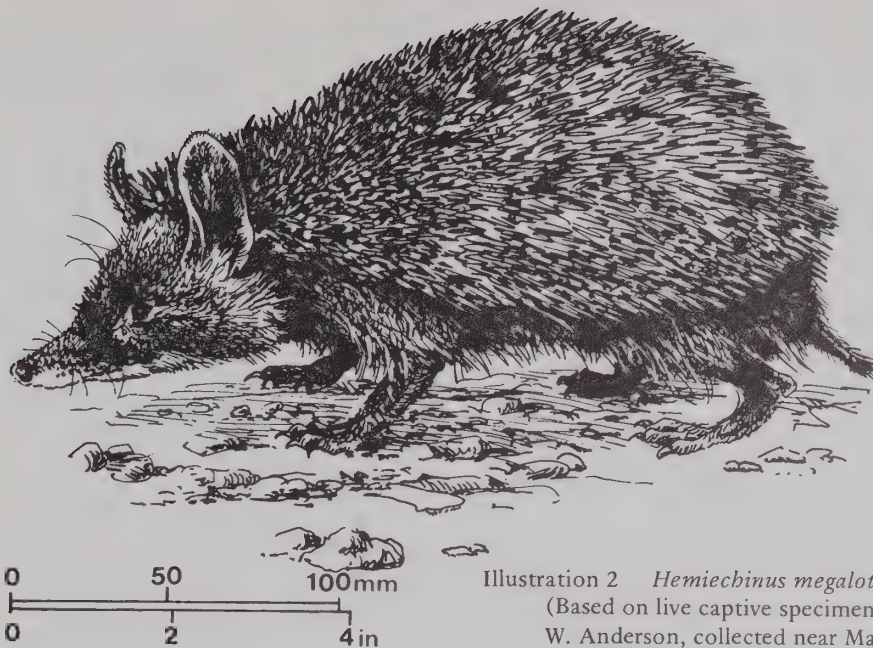


Illustration 2 *Hemiechinus megalotis*: Afghan Hedgehog.  
(Based on live captive specimen in possession of J. A. W. Anderson, collected near Mastung, Baluchistan.)

and the spines give an impression of lying in rather smooth and regular pattern compared with *H. auritus*.

**Distribution and Status:** The Afghan Hedgehog is confined to steppic mountainous regions (typically *artemesia*-steppe) and is extremely common in parts of Baluchistan particularly around Kalat State and Kharan. It occurs in the Chiltan Hills and Pishin and Ziarat, where I have trapped it at 8000ft elevation. It appears to be less common in northern Baluchistan and there are no definite records from the North West Frontier Province.

Lay (1967) describes it as being extremely abundant in the Seistan region of eastern Iran. Dr. Niethammer (1969A) collected this species in south-eastern Afghanistan as well as between Kabul and Kandahar. It extends into Russian Turkistan though some Russian authorities consider this as a separate species *H. chorassanicus* (Ognev, 1928).

This species does come into conflict with man because of its fondness for ripe melons, though it is largely beneficial because of the insects and reptiles which it consumes. Though limited in distribution it is quite plentiful above 3000ft and may be found in valleys up to 8200ft.

**Biology:** This species seems to differ slightly from *H. auritus* in being more sluggish in habits and in having more limited active periods during the year. Hibernation lasts from October up to March and may be from  $5\frac{1}{2}$ –6 months in duration. During periods of food scarcity even in the summer months they will undergo periods of aestivation.

Its habits otherwise are similar to *H. auritus* in that it is nocturnal in activity, non-gregarious and excavates its own burrows, the fore-feet being armed with well developed claws. Generally they excavate their burrows under a large stone or rocks and they are capable of digging in quite hard soil using only their fore-feet. It does not use its snout to assist in digging. Since the regions where it goes into hibernation experience extremely cold winters with temperatures down to  $-6\frac{1}{2}^{\circ}\text{C}$  ( $20^{\circ}\text{F}$ ), it can be assumed that the body temperature of this species also drops close to freezing during hibernation.

Not much is known about their food habits but they are not exclusively carnivorous as has been observed with *H. auritus* and it is known that they will feed on ripe fallen mulberries (*Morus alba*) in Baluchistan and this fruit forms a substantial part of their diet in late April and early May. Also in June they are very fond of water melons which they will hollow out just as they are ripening. They are immune to the stings of poisonous spiders (*Galeodes* spp.) and scorpions (*Scorpio* spp.) which they will readily attack and eat. They are probably able to catch and eat some of the numerous small skinks (*Lacertidae* spp.) as well as scorpions of the Genera *Buthus* and *Scorpio* which are common in Baluchistan and which are found in the same hilly habitat. Snakes and various beetles and orthopterous insects are no doubt included in their diet. Like *H. auritus* it is a voracious feeder and captive specimens show a tendency towards cannibalism.

Since there is no monsoon influence in the region which they inhabit, mating probably takes place immediately after emerging from hibernation and litters are produced in the late spring and early summer. A wild caught female produced a litter of five on 14 April (J. A. W. Anderson, pers. comm.). There is evidence from captive specimens that this hedgehog is more prolific than either of the *Paraechinus* species inhabiting Pakistan with litter sizes of five and even six regularly occurring. The females excavate a nest chamber in their underground burrow before giving birth to a litter. There is no evidence that more than one litter a year is produced.

Being quite abundant in parts of Baluchistan this hedgehog undoubtedly forms an important prey species both for the Hill Fox (*V. vulpes griffithi*) and the Rock-Horned Owl (*B. bubo turcomanus*). A cliff nest of this owl was found to have casts (regurgitated pellets) composed largely from the spines from this hedgehog though how it succeeds in overcoming this animal without injury to itself is a mystery, since Owls normally kill their prey by gripping with their feet and inflicting deep wounds with their talons.

Nothing has been recorded about the longevity of this species.



Genus **PARAECHINUS** Trouessart, 1879

### Key to the Pakistan Species of **PARAECHINUS**

- (i) Fur on belly and upper part of face whitish with limbs and snout contrasting reddish-grey. Spines white-tipped. Small size, head and body 130–185mm, exceptionally up to 190mm.  
... *Paraechinus micropus*
- (ii) Size variable but belly fur always black or reddish-brown and same colour as legs. Spines black tipped. Head and body over 200mm.  
... *Paraechinus hypomelas hypomelas*.
- (iii) As in (ii) above but with head and body under 190mm. Upper part of face and around ears with white hairs.  
... *Paraechinus hypomelas blanfordi*

### **PARAECHINUS MICROPUS**

*Paraechinus micropus* Blyth, 1846; Indian Hedgehog or Pale Hedgehog (see Illustration 3).

**Description:** The Indian or Pale Hedgehog is a comparatively small hedgehog and much paler in colouring than the other three species inhabiting Pakistan. The body spines have a fairly extensive creamy-white tip (see Fig. 6) and the upper part of the face and cheeks is greyish-white. The limbs, belly and area round the eyes and muzzle are clothed with reddish-brown hairs. The face shows a characteristic masked pattern with the white and grey hairs on the upper part (see Fig. 7). This same mask pattern occurs in *P. aethiopicus* which occurs in North Africa and may be conspecific. It has comparatively small ears. In the Pakistan population there is some variation in the general colouration with some specimens being darker brown and others verging to albinism. The spines are of medium length averaging about 19–23mm. The tail is comparatively short and stumpy and scantily clad with hairs. Adults in Pakistan rarely exceed 16cm in body length. Four specimens from Sind measured as follows: Head and body length averaging 155.5mm (range 130–194mm), with the tail averaging 12.5mm (range 12–13mm), the hind foot



*Paraechinus micropus* Known distribution  
Probable range

### Distribution Map 2 Indian or Pale Hedgehog.

averaging 25mm (range 24–26mm) and the ear averaging 25.5mm. The claws are noticeably short in this hedgehog when compared with *H. auritus* and *H. megalotis*.

**Distribution and Status:** The original type of this species was described by E. Blyth from Bahawalpur. But there are no subsequent records nor any specimens in any museum collection from either Bahawalpur region or northern Sind and according to all available evidence it only occurs from Hyderabad southwards being more abundant in Tharparkar and throughout Thatta District. It extends along the coast into Las Belas to the west but there are no records from the Mekran coastal region. Extra-limitally, this species has extended its range through Kutch in India and right down into the Deccan. Absent from the dryer

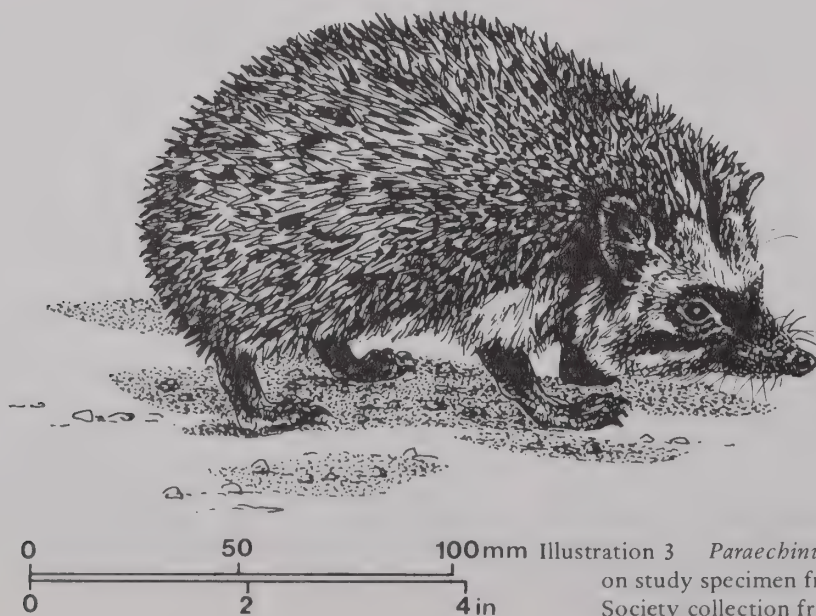


Illustration 3 *Paraechinus micropus*: Pale Hedgehog. (Based on study specimen from the Bombay Natural History Society collection from Thatta, Sind.)

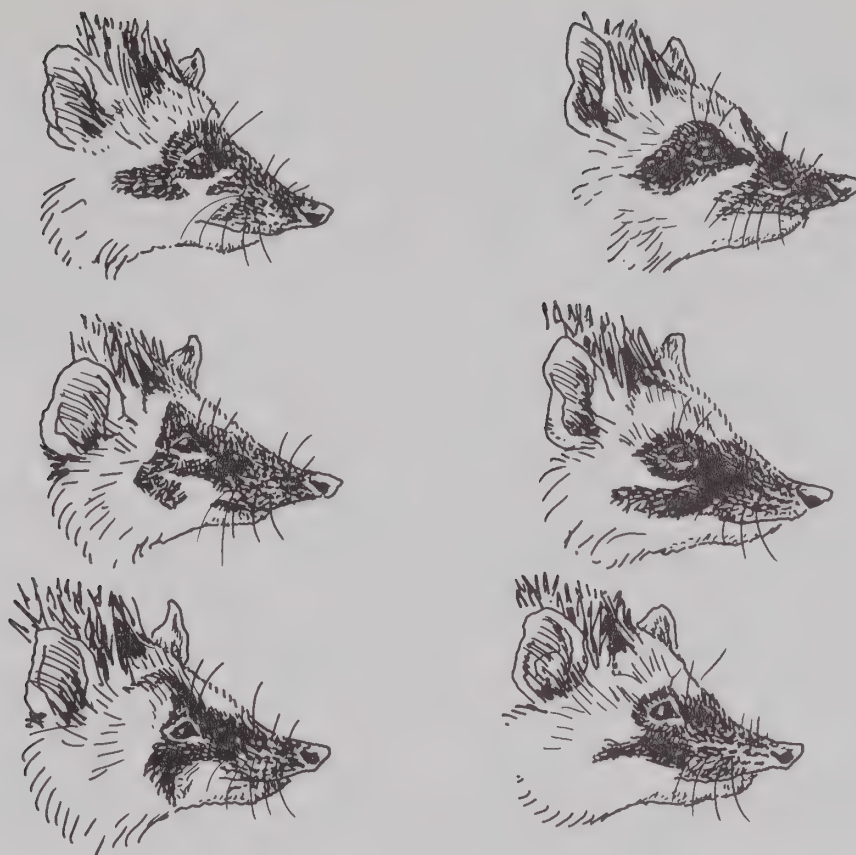


Fig. 7 Showing variation in face mask pattern of *Paraechinus micropus*. These six specimens were all collected from southern Sind.

parts of Rajhastan it does occur in the extreme eastern part where monsoon influence produces slightly more mesic conditions. It does not occur outside the subcontinent.

It must be considered comparatively uncommon in Pakistan and of very local distribution. It is sympatric with *H. auritus* in the regions where it occurs.

**Biology:** The habits of this hedgehog are much like those of *H. auritus* except that they sometimes shelter by day under a pile of brush-wood or a bush and do not always enter burrows. Observations on captive specimens show that they are less inclined to excavate burrows than captive specimens of *H. auritus* (Krishna and Prakash, 1955). They are nocturnal and like *H. auritus* travel at considerable speed when they are pursuing prey. Studies in Rajhastan showed that this hedgehog subsisted largely upon insects particularly Dung Beetles (*Helicopriss bucephalus*). They also feed on frogs (*Rana tigrina*) and toads (*Bufo arenarius*). They are perhaps more omnivorous in diet than *H. auritus* and will certainly tackle snakes, scorpions (*Butus* and *Scorpio* species), solifugid spiders (*Galeodes* spp.) and lizards (*Uromastix hardwickii* and *Mabuya macularia*) (Prakash, 1959) as well as eating the ripe fallen fruits of *Zizyphus*.

The breeding season extends throughout the monsoon period with litters being born from July to September when insect life is most abundant. They seem to be less prolific than *H. auritus*, one to two young being normal (Prakash, 1960A). Studies by D. Krishna (1955) indicated that this is a rather sedentary species which keeps to the same territory and often occupies the same burrow throughout a twelve month period.

This hedgehog is not as abundant as *H. auritus* wherever it occurs but it is no doubt preyed upon by foxes as well as jackals and the Grey Mongoose (*H. edwardsi*).

Though this species does not hibernate and there is plentiful insect life even in the winter months, it no doubt undergoes temporary periods of torpidity, when it remains curled up in some hole when food or water conditions are adverse. Captive specimens of this species, like their congeners can undergo prolonged fasts (3–4 weeks) without apparent harm.

#### PARAECHINUS HYPOMELAS

*Paraechinus hypomelas* Brandt, 1836; Brandt's Hedgehog.

*Paraechinus hypomelas hypomelas* Brandt, 1836 –

Brandt's Greater Hedgehog or Migratory Hedgehog.

*Paraechinus hypomelas blanfordi* Anderson, 1878 –

Blanford's Lesser Lowland Hedgehog.

This hedgehog is generally called Brandt's Hedgehog but the trivial name given above helps to distinguish these two subspecies which occur in Pakistan and are easily differentiated.

**Description:** Like *P. micropus* this hedgehog shares the distinctive feature of having a median parting of naked skin of the fore-crown on the head. In contrast to *P. micropus*, however, Pakistan individuals exhibit melanistic tendencies and *P. hypomelas hypomelas* is a very large hedgehog having long spines and being equal in size to *H. megalotis*. Six adult specimens from Baluchistan averaged 246mm head and body



length (range 205–286mm) with an ear length averaging 47.2mm (range 42–55mm), the tail averaging 30.6mm (range 25–38mm) and the hind foot averaging 41.4mm in length (range 31–46mm). The spines may attain a length of 37mm ( $1\frac{1}{2}$  in.) and they have black tips often with the entire distal third being black (see Fig. 6). The belly, legs and face are covered with a mixture of black and grey hairs and generally the middle part of the forehead has more black hairs with an admixture of grey hairs on the sides of the face. The throat also has a mixture of creamy-white hairs. This is a long legged hedgehog and the ears are considerably bigger than those of *P. micropus*.

*P. hypomelas blanfordi* is a small hedgehog equal in size to *H. auritus* but having the parting in the spines on the forehead. The general body colour is blackish-brown with black tipped spines but in the field it can often be distinguished from *H. auritus* by the presence of grey and white hairs about the ears and the upper part of the crown and cheeks. The face is greyer than that of *P. b. hypomelas*. There is a good photograph of a live specimen of this race in Guy Mountfort's book about his two expeditions to Pakistan (Mountfort, 1969). In line with its much smaller size the spines rarely exceed 17mm ( $\frac{5}{8}$  in.) in length.

The average head and body length of twenty-one specimens from the Punjab, Sind and N.W.F.P. was 180.4mm (range 151–205mm) with the ear averaging 36.6mm (range 29–42mm) and the hind foot averaging 33.5mm (range 30–36mm) and the tail averaging 33.2mm (range 21–48mm). It will be seen that the ear is comparatively shorter than in either *H. auritus* or *H. megalotis*. Forms of this hedgehog found in Arabia also show strong melanistic tendencies (Harrison, 1964). In Russia however there are two colour forms of this hedgehog, one having much paler horn-coloured spines (Ognev, 1962 and Flint et al., 1965).

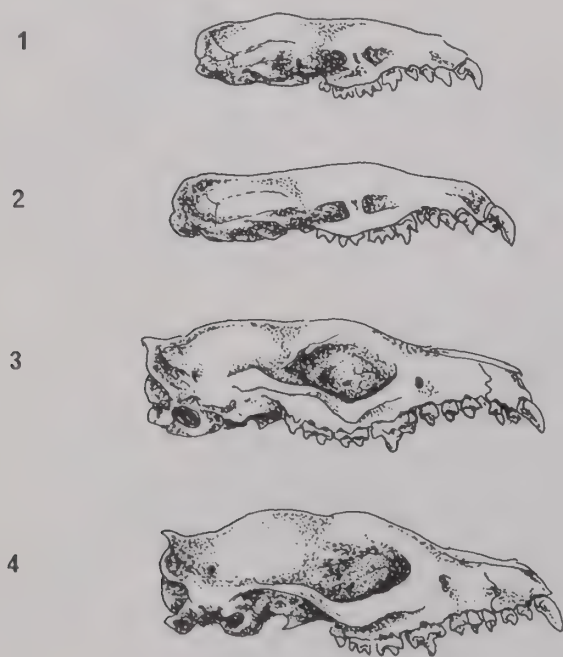


Fig. 8 Showing lateral view of hedgehog and shrew skulls.

1. *Crocidura russula*.
2. *Suncus murinus*.
3. *Paraechinus hypomelas*.
4. *Hemiechinus auritus*.

Note the two shrew skulls are drawn to a scale two times that of the hedgehog skulls.



*Paraechinus hypomelas blanfordi* Known distribution Probable range  
*Paraechinus hypomelas hypomelas* Known distribution Probable range

Distribution Map 3 Blanford's Lesser Lowland Hedgehog.  
 Brandt's Greater Hedgehog.

**Distribution and Status:** This hedgehog appears to prefer gravelly slopes or rocky areas and has not extended its range east of the Indus River to any great extent except in the north west Punjab in similar rocky terrain. It does not ascend as high as *H. megalotis* in Baluchistan and has not been recorded above 1200m (4000ft). It seems well able to survive in very barren arid areas.

*P. hypomelas hypomelas* occurs throughout southern Baluchistan at lower elevations and is found on the Sibi Plain as well as throughout the Mekran. It does not occur in any of the higher hill ranges and there are no records of this subspecies from the North West Frontier Province though it may well extend its range into the Kurram Valley and parts of Waziristan since it has been collected around the junction of the Kunar and Kabul Rivers in northeast Afghanistan (Hassinger, 1968). Dr. Lay found it rare in Iran though it is probably widely distributed throughout the southern part from Fars on the Persian Gulf to Kerman on the borders of Pakistan (Lay, 1967). *P. hypomelas blanfordi* occurs throughout Dera Ismail Khan District, Bannu and up to Peshawar and Mardan. It extends eastwards through the Salt Range and throughout the left bank of the Indus from Dera Ghazi Khan, the foothills of the Suleiman Range down to Larkana and Dadu Districts in Sind. It must have extended its range onto the alluvial plains of the Punjab because I have collected two specimens near Khanewal but there are no other records this far east and it must be considered very rare south of the Jhelum River or east of the Indus below its junction with the Jhelum River.

Both species are uncommon and rather erratic in distribution. The Blanford's subspecies being largely insectivorous is beneficial to man though the larger subspecies does some damage to melon crops in Baluchistan. In the Salt Range and the North West Frontier Province, Blanford's subspecies is sympatric with *H. auritus*.

**Biology:** Both subspecies of this hedgehog appear to be more nomadic in habits than the other hedgehogs inhabiting Pakistan and they probably travel over a greater area during the year and do not use the same shelter continuously. In fact they generally creep into some crevice between rocks or under an overhanging ledge and they do not seem to be very active burrowers. Compared to the other hedgehog species their legs look noticeably longer and the claws tend to be shorter and blunter which would be a disadvantage in a species which depended on burrowing.

Like the rest of the family, they are voracious feeders and will tackle almost any prey from venomous snakes to beetles. In years when the desert locust (*Schistocerca gregaria*) is plentiful, this forms the bulk of their diet. There is evidence however that this hedgehog is more frugivorous than the other species inhabiting Pakistan and certainly in the southern part of Baluchistan they have developed a fondness for ripe melons which are an important crop during the summer. They regularly raid irrigated crops of ripe melons. They also feed on ripe mulberries and the Russian olive (*Eleagnus hortensis*) which are planted along the roadsides near areas of cultivation.

Not much is known about the breeding of this hedgehog. R. I. Ognev (1928) refers to a female producing a litter of four in mid May in Trans Caspia. A captive Baluchistan specimen gave birth to six young on 28 May but ate them all. Cannibalism is probably more prevalent amongst hedgehogs under conditions of captivity than in the wild state. Since this hedgehog is nowhere plentiful it is probable that the average litter size is 3–4. In southern Baluchistan the young seem to be born from the late spring to early summer and there is no evidence that more than one litter a year is produced. Nothing is known about the breeding season of Blanford's subspecies which extends to the Indus riverine basin and it may be that breeding extends throughout the summer in these non-mountainous regions where there is some monsoon influence.

Observation on captive specimens indicates that Brandt's Hedgehog besides being more active than *H. megalotis*, is much more aggressive. They will readily attack other hedgehogs if confined in a small space with other species and some individuals evince anger even in the presence of human intruders (Ognev, 1928). J. A. W. Anderson observed that when this species was confined with *H. megalotis* that the former exhibited another interesting behavioural trait. At night-time they showed a strong inclination to clamber onto raised objects or up ledges and it appears that they deliberately sought higher ground before preparing to sleep during the daytime, whereas *H. megalotis* tried to choose some dark corner. Since this species often migrates considerable distances in search of food it appears that they try to crawl into suitable shelter on higher slopes or ridges for daytime shelter.

Brandt's Hedgehog is probably preyed upon by foxes, jackals and Rock-horned Owls (*Bubo bubo*).

## FAMILY SORICIDAE – SHREWS

This is the largest family within the Order *Insectivora* with from 20 to 16 separate recognized genera (Corbet, 1966 and Walker et al., 1964) and with over 200 different species having been named.

They occur over most of the world except Australia and

most of South America, but seem to be everywhere dependent upon fairly mesic conditions. They are mostly small mouse-like mammals (see Fig. 9) varying in size from the rat-sized Musk Shrew to the Etruscan Pigmy Shrew which is the smallest mammal in the world and it is interesting that both these two sizes within the family occur within Pakistan territory.

Shrews are largely insectivorous or carnivorous and some species have poisonous salivary glands with which they can overcome prey larger than themselves. Some forms have a scent gland in the flank which is more noticeable during the breeding season. They depend mainly upon an acute hearing and sense of smell, having relatively weak eyesight. It is believed that some forms may even employ echolocation and that the complicated folds in the ear pinnae are related to this function.

They are believed to be of very ancient phylogenetic origin, and all forms shed their deciduous (milk) teeth while still in the foetal stage. They also have a combined urinary and genital opening with the exception of the Genus *Sorex*.

## Key to the Family Soricidae in Pakistan

1. (A) Tail evenly covered with short hairs and teeth red or brown tipped. Head and body length 61–74mm (see Fig. 10).  
... *Sorex minutus*.
- (B) Tail showing a scattered sprinkling of longer hairs (see Fig. 9) and teeth all white without red tips.  
... 2.
2. (A) Four small unicuspid (single pointed) teeth behind each anterior upper incisor tooth – Genus *Suncus*.  
... 3.
- (B) Only three small unicuspid teeth behind each anterior upper incisor – Genus *Crocidura*.  
... 4.
3. (A) Size very large for a shrew. Unusually pale grey dorsally. Head and body 110–140mm. Hind foot 14–24mm.  
... *Suncus murinus*.
- (B) Size medium. Dorsal fur pale rufous grey. Head and body 66–72mm. Hind foot 11–14mm.  
... *Suncus stoliczkanus*.
- (C) Size very small. Dorsal fur dark brownish-grey. Ears comparatively large and conspicuous. Head and body 40–47mm. Hind foot 6–8mm.  
... *Suncus etruscus*.
4. (A) Dorsal fur dark blackish-brown. Head and body 60–75mm. Hind foot 11–14mm.  
... *Crocidura russula*.
- (B) Dorsal fur very pale reddish-grey. Head and body 50–55mm. Hind foot 12mm.  
... *Crocidura pergrisea*.

## Genus SOREX Linnaeus, 1758

### SOREX MINUTUS

*Sorex minutus* Linnaeus, 1766; Pigmy Shrew or Lesser Shrew.

**Description:** This is the only shrew known to occur in Pakistan with red-tipped teeth (see Fig. 10). All five other known species have teeth covered with only white enamel.

It is a medium-sized shrew with a relatively long and well-furred tail. The average tail length of nineteen specimens



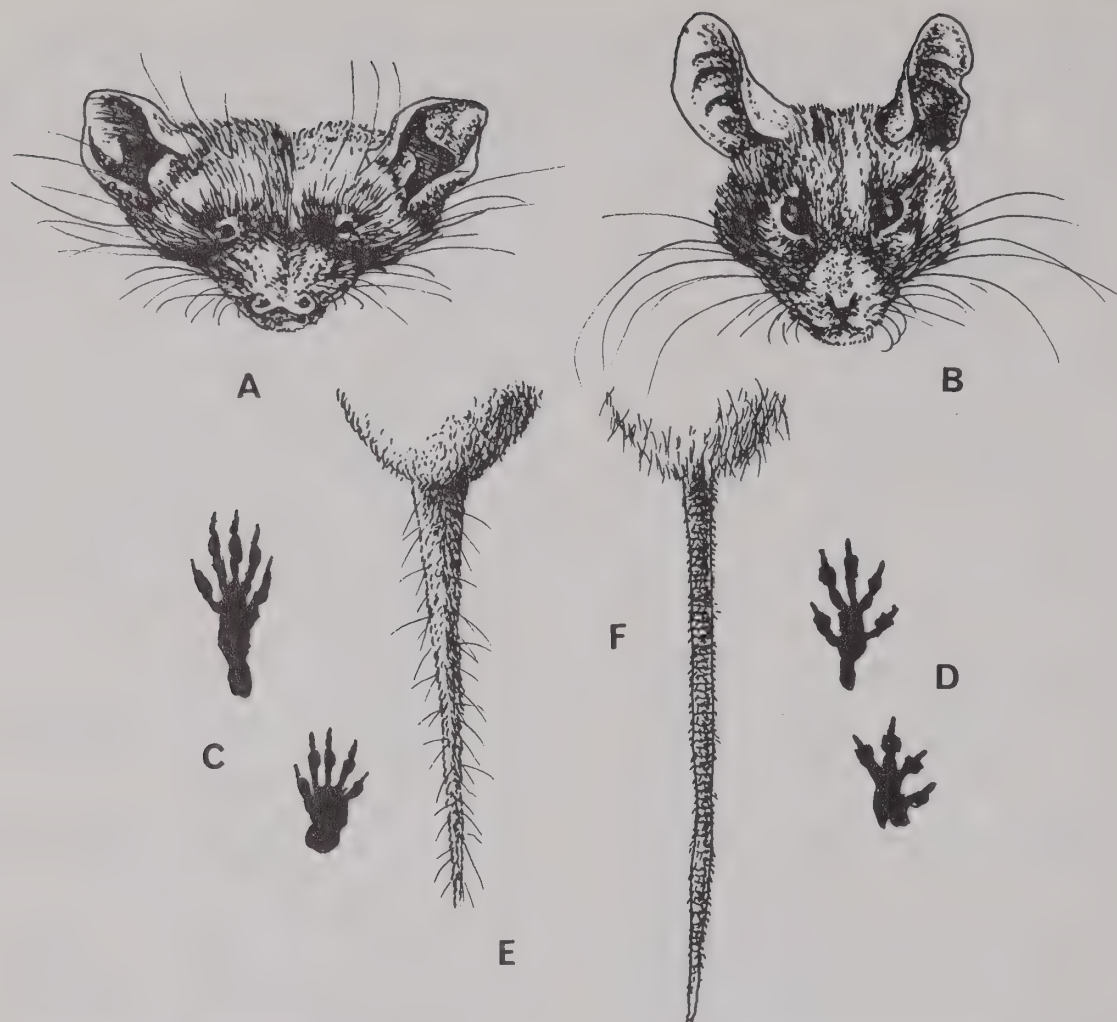


Fig. 9 Showing differences between mice (*Muridae*) and shrews (*Soricidae*).  
 A. Head of *Suncus* species.  
 B. Head of *Mus* species.  
 C. Right hind foot followed by right fore-foot print

or tracks of *Suncus* species.  
 D. Right hind foot followed by right fore-foot print or tracks of *Apodemus* species.  
 E. Tail of *Suncus* species or *Crocidura* species.  
 F. Tail of *Mus* species.

from Pakistan being 43.4mm (range 37–48mm) with the head and body length averaging 64.6mm (range 57–74mm). The hind foot averages 11.9mm (range 10–13mm) with the ear averaging 6.1mm (range 5–8mm). The tail lacks any scattering of long stiffer hairs which characterize the tails of all *Crocidura* and *Suncus* shrew species. It is a considerably smaller shrew than the Common White-toothed Shrew (*C. russula*) which might occur in the same Himalayan regions of Pakistan but compared with Savi's Pigmy Shrew (*S. etruscus*) it is medium sized and the name Pigmy Shrew therefore may be misleading.

The body fur is short, dense and dark grey-brown in colour with the ventrum being quite dark coloured greyish-brown and not markedly paler than the dorsal fur. Like all the Genus *Sorex*, the Lesser Shrew has five unicuspid teeth in the upper jaw, but it can be distinguished from other *Sorex* Shrews by having a rather prominent and sharp second cusp to its upper incisor (see Fig. 10). Also the unicuspid teeth on the upper jaw decline quite evenly in size from front to rear so that the fourth and fifth teeth are quite prominent and visible. There are four molariform teeth.

Adult specimens weigh from 2.5g up to 7.5g (0.1–0.25oz). The skull averages about 15mm ( $\frac{9}{16}$  in.) in length and the hind foot is usually under 11mm ( $\frac{7}{16}$  in.) in length.

**Distribution and Status:** Only known from the Kaghan Valley in Hazara District where the University of Maryland Expedition collected a fine series from Shogran in coniferous forest as well as in the northern alpine regions well above the tree line near Gitidas, the Babusar Pass at 3600m (12,000ft) elevation and Saiful Maluk Lake.

Ellerman and Morrison-Scott (1951) state that this shrew 'apparently occurs in Kashmir' as it was collected at Dachan-Kishtwar by Miller presumably within the first decade of this century. There are no British Museum specimens from the Himalayas and it has not apparently been recorded since from the Himalayan regions of India or Pakistan until it was discovered in 1964 by the University of Maryland Expedition. It seems to be plentiful in the Kaghan Valley though nothing is known of its status or occurrence outside this limited area. It is not included in the published checklists of M.S.U. Siddiqi or Z. B. Mirza (Siddiqi, 1969 and Mirza, 1970). In Iran it has only been collected in Khorasan (Lay, 1967). Apparently it does not occur in the Murree Hills where *Crocidura russula* has been collected.

It is evidently a species well able to withstand cold and to survive at high altitudes and it is noteworthy that this same species has been collected on the summit of Ben Nevis in the Scottish Highlands.

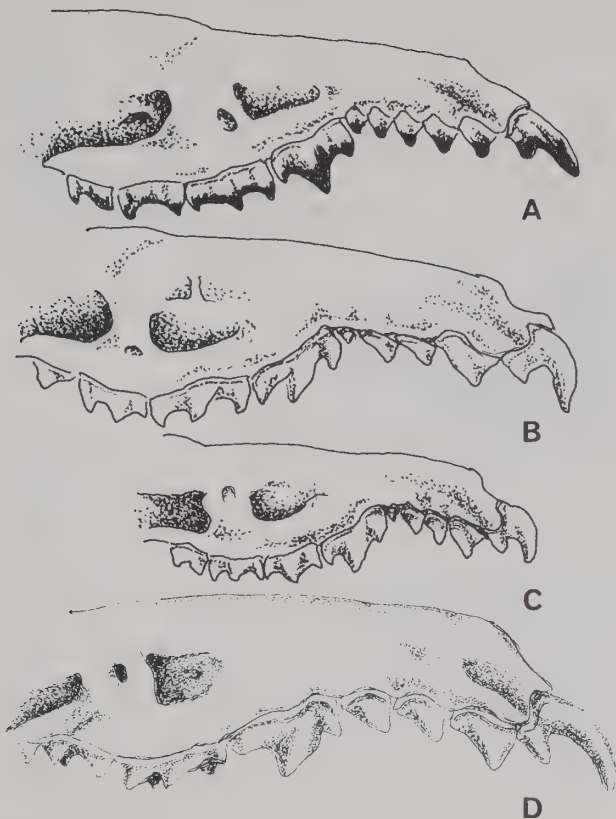


Fig. 10 Showing upper tooth row of shrew species.

- A. *Sorex minutus* with five unicuspid teeth behind outer incisor.  
 B. *Suncus stoliczkanus*. Note fourth unicuspid tooth much reduced in size.  
 C. *Suncus etruscus*.  
 D. *Crocidura russula*. Note only three unicuspid teeth behind outer incisor.



- Sorex minutus* Known distribution  
 Probable range  
*Crocidura russula* Known distribution  
 Probable range

Distribution Map 4 Pygmy Shrew or Lesser Shrew.  
 Common White-toothed Shrew.

**Biology:** Nothing has been recorded for Pakistan but they seem able to survive at amazingly high altitudes having been trapped in alpine rocky slopes at 3600m (11,800ft) in Gitidas in the Kaghan Valley in regions which are covered with snow eight months of the year. Presumably they live on various species of arthropods, woodlice and beetles. In Europe where this shrew has been well studied, the females produce two litters a year in the summer. Usually offspring from the previous summer produce their first litter the following spring at nine to ten months of age. Breeding extends up to about August and the gestation period is believed to be about twenty-two days (H. N. Southern, 1964). Shrews are very quick maturing and short lived and the Pigmy Shrew is typical in this respect. The young are weaned at about twenty-two days and they are equal to their parents' weight within about fourteen days of birth. Surprisingly the young do not open their eyes until one or two days before they are weaned and remain blind for the first eighteen to twenty-one days of their lives.

Apparently in this species as in other *Sorex* Shrews the young do not form trains or caravan processions when following their mother as is commonly the case with *Suncus* and *Crocidura* shrews. When weaned they lead solitary lives and are non-gregarious. They are active throughout the year and do not hibernate so there is probably considerable mortality amongst adult shrews in the harsh winter months.

#### Genus *SUNCUS* Ehrenberg, 1833

##### *SUNCUS MURINUS*

*Suncus murinus* Linnaeus, 1766; House Shrew (see Illustration 4).

Subspecies *Suncus murinus tytleri* Blyth, 1859  
 and *Suncus murinus sindensis* Anderson, 1877

**Description:** The House Shrew, apart from its exceptionally large size, is a fairly typical shrew in shape and appearance, having a relatively small black eye, long pointed mobile snout and profuse soft vibrissae. The naked ear has rather distinctive folds within the conch, giving a crumpled appearance (see Illustration 4). The body fur is very short, dense and velvety and of a uniform pale ashy-grey colour sometimes with a brown wash. This colouration characterises the population inhabiting the plains. (*S. murinus sindensis*). House Shrews from the northern regions of Hazara District and Himalayan valleys are much darker with dorsal fur blackish-grey and I consider these should be assigned to the subspecies *S. murinus tytleri* (Blyth, 1859). The belly fur is not markedly different in colour. The tail which is thickened at the base tapers to a fine point and bears the usual sprinkling of longer whitish hairs. The muzzle is only sparsely haired and pinkish in colour, as are the ears. Compared with many of the *Sorex* Shrews the ear seems comparatively large. In male specimens the flank gland is often marked by a tiny patch of bristly white hairs. The female has only three pairs of mammae located in the inguinal region (see Illustration 4).

The upper tooth row consists of one incisor, no canines, four palatal premolars and one maxillary molar followed by three molars. *Crocidura* species have only three palatal premolars. Ten adult Musk Shrews from various parts of Pakistan averaged 137.4mm (range 119–147mm) head and body length with the tail averaging 76.25mm (range 60–85mm), the hind foot averaging 20.5mm (range 19–22mm) and the ear averaging 13mm.

It is very difficult to determine the age of shrews from





Illustration 4 *Suncus murinus*: Indian Musk Shrew or House Shrew. (Based on live captive specimen, adult female, collected Karachi.)  
A. Detail of right external ear conch.  
B1. Left hind foot underside.  
B2. Left fore-foot underside.  
C. Adult female.

examination of their teeth since their deciduous teeth are shed while they are still in the foetal state and they are born with their permanent teeth just erupting. The relative size of the ear would appear comparatively larger in sub-adult House Shrews than in the more delicately built Anderson's Shrew, with which the House Shrew could be confused.

**Distribution and Status:** The House Shrew is more adapted to a commensal existence with man than any

other member of the Family but it also hunts in gardens and hedgerows around the outskirts of villages and towns.

It is a truly oriental species and is much more widespread in the more humid regions of the subcontinent and has spread into Pakistan around the Karachi area and in the extreme northwest of the Punjab around Lahore and Sialkot and eastwards through Rawalpindi. Finding more humid conditions in the Himalayan outer foothill tracts it has been able to spread through Mardan, Swat and Dir as well as through the lower part of Hazara District from Abbottbad through Manshera and even Balakot at the mouth of the Kaghan Valley. Because of its commensal tendencies it has been carried through human agencies into relatively arid zones and it has spread throughout southern Sind to all the larger towns as well as up the Indus to Sukkur. It has been collected on the right bank of the Indus at Sehwan and Jacobabad. It has not spread into some of the newer canal colonies of the Punjab and I have found no evidence of it in the Multan or Khanewal areas though it occurs in Lyallpur (Taber, 1967). The University of Maryland Expedition collected specimens from near Kohat, Rawalpindi, Malakand as well as at Changa Managa forest plantation forty-three miles south west of Lahore. I have collected it at Choa Saidan Shah in the Salt Range and at Charsadda in the North West Frontier Province. There are reports of its occurrence around Bahawalnagar though it has not been collected there in recent decades.

Extra-limitally, it occurs throughout India, Ceylon and Burma, Malaysia, south eastern China, Taiwan and Indonesia but it does not appear to have spread westwards into Baluchistan and there are no recent records from Iran (Lay, 1967) though specimens have been collected from the Persian Gulf seaports (Harrison, 1964). The only locality where it has been recorded in Afghanistan is around Jalalabad (Hassinger, 1968).

Outside of Karachi and the larger cities of north west Pakistan the Musk Shrew must be considered rare or absent.



Distribution Map 5 *Suncus murinus*: House or Musk Shrew.

It is undoubtedly beneficial to man, particularly in destroying cockroaches and it is even said to discourage rats from occupying houses. Because they attract attention to themselves by their smell and noisy squeaks they often are trapped and destroyed by householders, particularly Europeans who are not used to them. Because of their activity in keeping down cockroaches their presence is tolerated and even welcomed in many Indian villages and it is believed that they may have been deliberately spread by man to some of the larger seaport towns in the Middle East (Harrison, 1964).

**Biology:** The House Shrew is not a gregarious species and generally lives a solitary existence. In contrast to shrews from more temperate latitudes it is largely nocturnal in feeding activity. They are typically shrew-like in having voracious appetites and spend the hours of nightfall scurrying about using their sensitive noses and hearing to detect prey. It is believed that their hearing is very acute though their eyesight is poor. Inside buildings they generally prefer to scurry along close to the angle between floor and wall. In the garden they keep under low growing plants and leaves, etc., concealing their bodies as much as possible. They are omnivorous in diet and there have been many accounts of their attacking prey much bigger and heavier than themselves. There are authentic records of this shrew attacking and eating Tiger Frogs (*Rana tigrina*) (Wasey, 1896, and Dharamakumarsinghi, 1937), also a 45.75cm (18in.) long Keel Back Snake (*Natrix atollata*) (Behura, 1958). Their normal food is however insects, particularly crickets (*Grillidae* spp.) and cockroaches (*Blattaria* spp.). They have also been recorded as eating leeches which they took out of a jar of water (Raj, 1959). They will eat vegetable matter also, and captive specimens readily take both bread and cheese. It is also recorded that this shrew can inflict damage on a garden lawn digging out and eating the bulbs of a grass known locally as 'bimly' (Millard, 1920). Whilst hunting they sometimes emit a shrill chattering squeak and are particularly noisy during intraspecific encounters. Their squeaks have been fancifully likened by the Chinese to the sound produced by 'clink-clinking' money. It is not difficult to tame this shrew and there are many accounts of specimens thus kept. One such shrew showed great dexterity in capturing flies (*Diptera* spp.) on the wing, rising on its hind legs and snapping at them with lightning head movements (Crump, 1912). Another pair of House Shrews which were free became so tame that they would come and eat crickets out of the house-owner's fingers (Eates, 1968).

Before breeding, the female builds a nest generally concealed in a crevice or under a pile of rubbish in some little frequented storeroom. These nests are often made from chewed pieces of paper and rags. In Pakistan there seem to be two peak breeding periods with more pregnant or lactating females being trapped in the spring as well as towards the end of the monsoon. Litter sizes of 3-4 seem to be fairly normal. In Lyallpur a female with three foetuses was trapped in March, and juvenile shrews were trapped in late September and early October (Taber, 1967). Newly-born shrews are naked with pink skin and in one litter they averaged 3.1g (1/10 oz) at birth (Medway, 1969). In Malaysia out of seventy-one litters recorded the average number of young was 2.7 with a variation of 1 to 5 (Medway, op. cit.). Baby shrews start to grow visible body fur within a few days and are fully furred by the tenth day. However their eyes do not open until the fourteenth or fifteenth day and they are weaned within less than a week of this time. The young remain with the mother for some time after being weaned

and it is a well known phenomenon that babies of the Genus *Suncus* have the habit of forming a train or caravan by holding firmly with their mouths onto the tail or hind quarters of their mother or litter-fellow. These shrew trains have often been described and a photograph of one such train is illustrated in Z. B. Mirza's book (Mirza, 1970). Presumably the mother when she encounters something edible indicates this to the young, who are clinging on to her, whereupon they break up the caravan and fall upon the food. It is not known how many days the young remain dependent upon the mother like this but judging from their relative size it is thought to be for two or three weeks.

The House Shrew has lived up to one-and-a-half years in captivity but it is probable that in the wild they generally do not live beyond one year. Many raptorial birds will not eat shrews, presumably because of their musky odour. K. R. Eates records watching a Black Kite (*Milvus migrans*) which picked up a dead Musk Shrew and took it to a nearby tree. After having pecked at it once, it threw the shrew to the ground (Eates, 1964). However, regurgitated pellets of the Spotted Owlet (*Athene brama*) near Karachi have been found to be full of the remains of the Musk Shrew (Dr. Walton, pers. comm.). It is well known that owl species in Europe prey upon shrews. No doubt they fall victim to mongooses and snakes which are not uncommon in the vicinity of villages.

**SUNCUS ETRUSCUS**

*Suncus etruscus* Savi, 1822; Savi's Pygmy Shrew, Mediterranean Pigmy Shrew or Etruscan Shrew.

**Description:** This tiny mammal is much darker than other shrew species inhabiting the plains of Pakistan with the dorsal fur very dark brownish-grey and the belly a slightly paler silvery-brown. The fur is so short that it truly seems to have the texture and appearance of velvet. The tail is generally one-half the head and body length and possesses the scattered longer white hairs characteristic of the Genus though



*Suncus etruscus* Known distribution  
Probable range

Distribution Map 6 Savi's Pygmy, or Etruscan Shrew.



due to its small size these are inconspicuous. The ear is relatively large and conspicuous in this Shrew. Practically no material from Pakistan has been measured but a specimen in the Smithsonian national collection from Sialkot district had the head and body 45mm ( $1\frac{3}{4}$  in.) and tail 29mm ( $1\frac{3}{8}$  in.). Specimens in the Bombay Natural History Society collection from different regions of India had the head and body length generally less than 42mm ( $1\frac{5}{8}$  in.) and ranged from 35mm ( $1\frac{3}{8}$  in.) up to an exceptional 48mm ( $1\frac{7}{8}$  in.) in one case. Tail length varied from 25–30mm ( $1-1\frac{1}{8}$  in.). An adult weighs hardly 7g ( $\frac{1}{4}$  oz.). This shrew is easily recognized from any other species occurring in the region by its small size and dark colouration.

**Distribution and Status:** This species may have a much more extensive distribution than is presently known because it is unobtrusive and rarely enters traps. It is not included in the checklist published by the Zoological Survey in Pakistan nor in Z. B. Mirza's book (Siddiqi, 1969, and Mirza, 1970). It has been collected from Malir, from the mouth of the Indus near Shah Bunder and the Hub River valley by J. A. W. Anderson. These specimens are lodged in the Royal Scottish Museum in Edinburgh. The University of Maryland expedition collected one specimen in Sialkot District near the Indian border on the right bank of the Chenab River and a mummified specimen from Amandra in the Malakand. It may occupy quite a wide range in the northern foothill zone.

Extra-liminally there are specimens from the Nilgiri Hills in South India as well as from Orissa and the Himalayas around Darjheeling, Bengal and Assam. It probably spreads eastwards and the Malaysian species *Suncus malayanus* (Kloss) should be regarded as a subspecies of *S. etruscus* (Harrison, 1966).

In Iran a single specimen was collected from Turkmen Plain in the extreme north near the Caspian Sea (Lay, 1967). It does not seem to have been recorded in Afghanistan (Hassinger, 1968). It ranges into the Trans-Caspian region of Khuzistan (Flint et al., 1965).

With the present limited information it must be considered rather rare and local in occurrence in Pakistan and it is of no economic importance.

**Biology:** This shrew has been so rarely trapped or observed that little is known about its habits. In the Mediterranean area it has been recorded as producing litters of from four to six. J. A. W. Anderson trapped a specimen from under some rotting leaves in Malir in early November which shortly thereafter gave birth to four young. Blind, pink and naked, they were hardly bigger than a house-fly at the time of birth. Their skin showed a peculiar silvery sheen in certain lights. It becomes pigmented dark grey within a few days. At ten days of age they were fully furred and about as dark in colour as the mother and very active. They grabbed each other's tails forming a caravan, one individual holding onto the mother whenever she left the box (J. A. W. Anderson and H. Strobl, pers. comm.).

Presumably they are capable of breeding throughout the year like other *Suncus* Shrews and the gestation period is about 28 days. No doubt the peak breeding activity is during and after the monsoon season from August to October, when insect food is most abundant.

Like all the shrews this species is a voracious feeder and will seize most invertebrates and is particularly fond of spiders as well as the smaller beetles and termites which they detect in leaf litter by their smell.

## SUNCUS STOLICZKANUS

*Suncus stoliczkanus* Anderson, 1877; Anderson's Shrew, the Yellow-Throated Shrew.

**Description:** This is a medium sized shrew characterized by comparatively large ears and pale grey colouration. The body fur is short, dense and soft with the upper part of the body being a pale silvery grey often with a rufous wash. The tail is about 50–70 per cent of the head and body length and is comparatively longer than the tail of the House Shrew which is approximately one-half of the head and body length. In specimens collected from Pakistan there is no trace of yellow fur around the throat or pectoral region. The belly fur is a paler silvery-grey with no distinct separation between the darker grey of the upper body. The fourth minute unicuspid tooth in the upper jaw is the only reliable feature which can separate this shrew from *Crocidura pergrisea* which has similar colouration and also occurs in Pakistan. Shrews of both these species have a scattering of longer paler hairs along the tail.

Six adult specimens from Pakistan had the head and body length averaging 72mm (range 58–80mm). The tail averaged 45mm (range 37–51mm). The hind foot generally averaged 11.8mm in length (range 11–14mm) and the ear averaging 9.17mm (range 8–10mm) in length.

**Habitat:** So few records have been established of the occurrence of this shrew that it is difficult to say what type of country it prefers. Specimens from the Sind and the Punjab have been collected from gardens and grassy embankments near water courses and it presumably prefers fairly mesic conditions with plenty of ground cover like all shrews. Specimens have been trapped from under piles of brush-wood in forest plantations in the Punjab as well as at the base of stone walls in Kathiawar.

The Bombay Natural History Society Mammal Survey collected a number from around Karachi, Thatta, Sukkur and Rohri indicating that it has probably spread up the Indus riverine basin throughout Sind. In 1974 Dr. G. W. Fulk collected specimens from the embankments between flooded paddy fields in Sujawal Sub-Division of Thatta District. The University of Maryland expedition collected specimens from Changa Manga Forest Plantation in the eastern Punjab. In the southwest Punjab they also occur since I have been able to secure two specimens over a period of six or seven years from my garden. Both had died naturally. Trapping attempts in the same vicinity have never resulted in capture of any of these shrews, however. (See Distribution Map 7.)

Elsewhere they have been collected in Kathiawar, Rajasthan and southwards through Bombay and Gwalior. Prior to receiving one Khanawal specimen, the British Museum and the Bombay Natural History Society collections had no specimens from Punjab. The Changa Manga Specimens are lodged in the Smithsonian national collection.

R. D. Taber collected from a relict patch of tropical thorn scrub near Lyallpur one specimen of a shrew identical in size and colouration to *S. stoliczkanus*. This specimen has been identified as *Crocidura pergrisea* and I have not been able to examine its skull. It is possible to collect specimens of *S. murinus* in which the third palatal premolar is entirely suppressed or absent resulting in a dental formula identical to *Crocidura* (Harrison, 1964). This indicates that the main distinguishing characteristic between these two genera relates to a feature which is probably becoming vestigial or redun-

dant in the course of evolution and until more specimens are available for comparison I would venture to suggest that *C. pergrisea* and *S. stoliczkanus* may not be wholly separable as distinct species. Such a conclusion is warranted after examination of all the limited material from this region in the British Museum, Smithsonian and Bombay Natural History Society collections. Two specimens of *S. stoliczkanus* in the Smithsonian with four upper unicuspid teeth discernible have been originally and wrongly labelled *Crocidura pergrisea*. These specimens are slightly more rufescent in body colouring than Khanewal specimens.

**Biology:** Breeding may well extend throughout most of the year except possibly during the coolest two or three months from December to February. In the warmer latitudes of Sind a female has been trapped in January which was apparently lactating. A juvenile estimated to be between one to two months of age was trapped near Sukkur on 27 January. A subadult specimen was collected in the south western Punjab in early October. Nothing definitely is known about litter sizes or gestation period, etc. Males of this species have a musk gland on the flank and captive specimens exhibit a lively aggressive disposition.

They probably feed largely on insects and various invertebrates and there is some evidence for believing that their bite may be partly poisonous due to the presence of specialized salivary glands. They certainly seem able to overcome and eat poisonous arachnida including solifugids and probably small scorpions (*Buthus* spp.) and Velvet Mites (*Dinotrombium* spp.) all of which abound in the hilly limestone regions of Sind where this shrew has been trapped.

As far as is known this shrew is largely nocturnal and solitary in habits and lives away from human buildings, having no commensal tendencies.

**Genus CROCIDURA** Wagler, 1832

**CROCIDURA RUSSULA**

*Crocidura russula* Hermann, 1780; Common White-Toothed Shrew (see Illustration 5).

**Description:** The Common White-toothed Shrew occurring in temperate climatic regions of Pakistan has comparatively longer fur when compared with other shrews of the Genus *Suncus* found in the plains of Pakistan. The body fur varies in colour from an even greyish brown to quite a dark mouse coloured grey-brown with the belly fur only slightly paler silvery-grey. As is typical of all shrew species the fur is dense, soft and silvery. There is no sharp dividing line between the darker dorsal fur and the paler ventrum which is a useful diagnostic feature in *C. leucodon* and *C. suaveolens*. The feet and tail tend to be silvery grey and paler. If compared with a subadult specimen of *S. murinus* the Common White Toothed Shrew will at once be noticed to have a longer and slimmer tail. Generally the tail is just under 70 per cent of the head and body length. A series of ten specimens from the Murree Hills had the head and body length averaging 68.4mm (range 60–75mm) with the tail averaging 46mm (range 38–52mm) in length, the hind foot averaging 13.1mm (range 12–14mm) and the ear averaging 8.7mm (range 7–10mm).

**Distribution and Status:** This shrew is a Palearctic species confined in Pakistan to the moister temperate regions of the Himalayas. It is typically associated with Himalayan moist temperate forest or the banks of streams in more dry and open hillsides where forest is lacking but there is sufficient ground cover in the form of shrubs and bushes. There are no records of its occurrence in the dryer mountain steppe regions. (See Distribution Map 4.)

It has been collected throughout the Murree Hills as well as Thandiani. It has also been collected in Azad Kashmir. Surprisingly there are no definite records as yet for Hazara District or Swat. In India it has been collected only from Kashmir. Dr. Niethammer (1965) collected it throughout the areas of north western and central Afghanistan and found that in the dryer mountain regions which lacked forest it always occurred in the vicinity of streams or swampy areas. In Iran it has been collected throughout the north, mainly in the Elburz and Zagros mountains (Lay, 1967). In the USSR it occurs from the Caucasus extending eastwards through Turkestan and into the Pamir Mountains

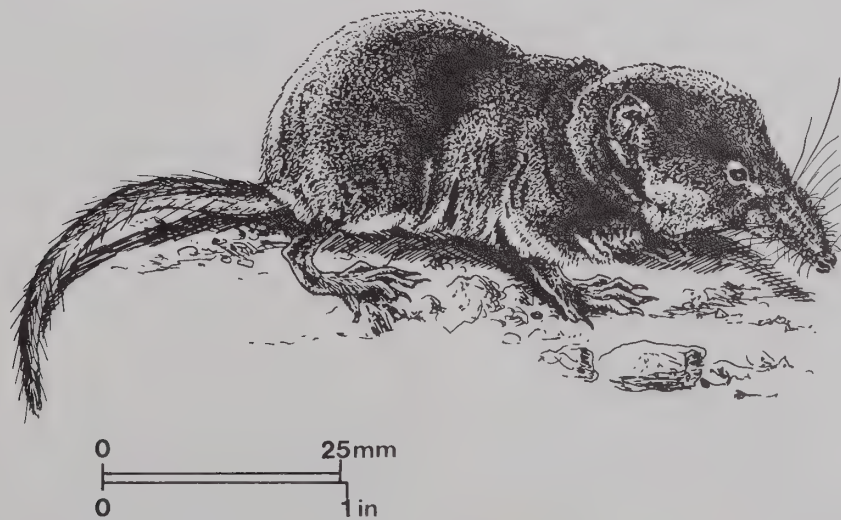


Illustration 5 *Crocidura russula*: Common White-toothed Shrew. (Based on study specimens from the Bombay Natural History Society collection, collected around Murree.)



(Flint et al., 1965). This shrew occurs in Japan and throughout the Mediterranean but surprisingly it has never colonized the British Isles.

So little material has been collected from Pakistan that all the shrew species present many unanswered questions and problems. *Sorex minutus* has been collected in the southern part of Hazara District in a similar biotope to the Murree Hills where *C. russula* occurs but *C. russula* has not yet been collected from Hazara District. Since it occurs in the same latitudes in Afghanistan there is no reason why it should not occur in intervening Himalayan territories such as Swat and Hazara District.

Until more material is available there remain many taxonomic uncertainties. In the checklist of Palearctic and Indian mammals *C. fuliginosa* has been listed as a separate form whose specific status is not determined (Ellerman and Morrison-Scott, 1951). All the series collected from the Murree Hills in the Bombay Natural History Society Mammal Survey were assigned to *Suncus fuliginosa*. Ellerman and Morrison-Scott stated that they should definitely belong to the Genus *Crocidura* because of their lesser number of unicuspid teeth. M. S. U. Siddiqi (1969) in his examination of British Museum material from Pakistan and Kashmir, labelled *C. fuliginosa*, opined that all these species from the Murree Hills should be assigned to *Crocidura attenuata* on the basis of the fact that the pads on the soles of the feet are dark in *C. attenuata* whilst *C. russula* lacks dark coloured pads on its feet (Siddiqi, 1970). It is difficult in dried skins collected more than forty years earlier to gain a clear impression about the colouring and appearance of the pads on the feet of these shrews and in view of the main distribution of *C. attenuata* in the rest of the subcontinent and the known distribution of *C. russula* in adjacent Russian and Afghanistan territories, I prefer to assign these Murree Hill shrews to *C. russula*. *C. attenuata* seems to be mainly confined to the more humid, warmer tropical rain forests of the eastern Himalayas, south west China and northern Burma.

Though not rare in the Murree Hills the White-toothed Shrew appears to be very limited in distribution in Pakistan territory.

**Biology:** The White-toothed Shrew has not been studied in Pakistan but from observations in other parts of its range it can be considered as partly active during daylight hours as well as darkness and to forage principally among leaf mould and under rotting logs. They are inquisitive, aggressive and voracious and feed on all kinds of invertebrates and insects. In the Murree Hills they can find an ample diet of *Gasteropoda* (slugs and snails) as well as millipedes (*Diploda*), centipedes (*Chilopoda*) as well as the larvae of insects and *Crustacea* such as wood lice. They no doubt supplement their diet with any carrion such as dead birds or mammals which they come across and may eat fruit in limited quantities. It is known that this species does not hibernate even when the ground is carpeted with snow and at this time they must rely on their acute sense of smell to search out the larvae of insects and other *Crustacea* which shelter under the soil surface and in the leaf and humus layer of the forest floor. This shrew will frequent gardens and human habitations and has actually been trapped inside houses in Murree.

There is no recorded information about breeding activity in Pakistan but the species is known to have a breeding season from March to October throughout most of the northern hemisphere (Flint et al., 1965 and Ognev, 1928). Probably Himalayan conditions in Pakistan would

enable a similarly extended breeding season. It is known that the gestation period is 28 days and that females produce litters varying from 3–7 and are commonly mated again immediately after parturition (Ognev, 1928 and Van den Brink, 1967). There are authentic records of females of this species producing seven successive litters in the period of one summer and autumn. The young are born blind and naked and are fully furred at about two weeks of age and sexually mature between two and three months of age. The young have the same attractive habit as the *Suncus* Shrews in forming a living caravan or chain following their mother when they first start foraging for solid food. It is recorded that some species of *Crocidura* have lived for four years in captivity (Walker et al., 1964). In the wild it is unlikely that most individuals survive their second winter and must therefore die at about 18 months of age. Females have three pairs of mammae like all *Crocidura* species, located in the inguinal region, the last pair being close to the root of the tail and beyond the cloaca, which is a combined urogenital opening.

Owls are the principal predator on this shrew as has been proved from the examination of regurgitated pellets. In the forest regions of the Murree Hills several owl species are plentiful, e.g. the Spotted Scops Owl (*Otus spilocephalus*), the Collared Pygmy Owlet (*Glaucidium brodiei*) also the Indian Scops Owl (*Otus scops*). Males of this shrew genus possess a musk gland on the flank and may be left alone by mammalian predators.

### CROCIDURA PERGRISEA

*Crocidura pergrisea* Miller, 1913; Pale Grey Shrew.

**Description:** As its name implies this is a rather pale coloured shrew much lighter grey in the dorsal pelage than the House Shrew or the Common White-toothed Shrew but it is about the same colour as *S. stoliczkanus*. Inhabiting warmer more southern latitudes it has much shorter fur than *C. russula* and also averages slightly smaller in size. Specimens of this shrew in the British Museum and Bombay Natural History Society collections are insufficient to enable adequate comparison with *S. stoliczkanus*. One specimen from Turbat in Baluchistan labelled *Crocidura portali* appears to be *C. pergrisea*. There are two specimens in the British Museum collection from Panjgur in Baluchistan. These three specimens indicate that the tail is often less than 70 per cent of the head and body length. The skull length is less than 22mm ( $\frac{7}{8}$  in.) for this species according to Ellerman and Morrison-Scott. The average size of these three specimens from Pakistan was 56mm head and body length with the tail 45mm average length, hind foot 12.3mm and the ear 9mm.

Presumably any medium sized shrew of pale grey colouration and having only 28 teeth in the upper jaw, collected from Pakistan, should be assigned to this species.

**Distribution and Status:** The Pale Grey Shrew appears to be a Palearctic species adapted to semi arid and relatively warm climatic conditions. It frequents arid mountainous regions in Baluchistan often in the vicinity of villages. In Iran the Street Expedition trapped it around cracks and holes in the base of mud walls in villages (Lay, 1967).

Several shrew specimens in the original Bombay Natural History Society survey of southern Baluchistan were named *Crocidura portali* and it seems probable that these should have been assigned to *C. pergrisea* (Wroughton,



*Crocidura pergrisea* Known distribution  
Probable range  
*Suncus stoliczkanus* Known distribution  
Probable range

Distribution Map 7 Pale Grey Shrew.  
Anderson's Shrew or Yellow Throated Shrew.

1920). These specimens, which are no longer available in the Bombay Natural History Society collection, were collected in Kalat State as well as Turbat and Panjgur. There are also specimens of *C. pergrisea* in the Bombay Natural History Society collection from Shingar in Baluchistan and another one labelled Gilgit. Two specimens collected from Lyallpur in 1966 have been assigned to *C. pergrisea* (Taber, 1967). I have examined one of these specimens in the British Museum and believe it to be *S. stoliczkanus*.

Until more evidence is available it appears that the Pale Grey Shrew is confined mostly to the dry hill regions west of the Indus as well as the inner dryer Himalayan ranges, and it may be relatively uncommon throughout these regions judging from the paucity of collected material.

**Biology:** Details of the life habits of this shrew must be largely a matter of speculation. Judging from the regions of Baluchistan where it has been trapped, it must be largely nocturnal in activity since there is practically no vegetative

ground cover and in the summer months the daytime temperatures are very high. This genus is believed to have poisonous salivary glands and the Pale Grey Shrew is probably capable of tackling besides insect prey, small lizards and amphibia. In Iran Dr. Lay reported finding lizards, snakes and scorpions as well as mice sharing the holes in crevices in mud walls where this shrew was trapped. In southern Baluchistan scorpions and tenebrionid beetles are plentiful and these are likely to enter into this shrew's diet.

Nothing has been recorded about its breeding habits or longevity.

In the regions of Baluchistan where it is known to occur the Little Owl (*Athene noctua*) is fairly plentiful and is probably a significant predator on this shrew.

### CROCIDURA ATTENUATA

*Crocidura attenuata* Milne-Edwards, 1872; Grey Shrew.

**Description:** There is a specimen in the Bombay Natural History Society collection from Murree which has been labelled *Crocidura bubricosa* and this has recently been assigned to *Crocidura attenuata* according to the label but it is a dark coloured specimen of rather large size which seems to correspond to *C. russula* in every other respect. The main distribution of this shrew as mentioned earlier seems to be in the more humid eastern regions of the Himalayas though specimens have been collected westwards as far as the Kulu Valley in India. Ellerman and Morrison-Scott (1951) also include the Punjab and Kashmir in the distribution of this species. Specimens in the British Museum labelled *Crocidura fuliginosa* have been assigned to *Crocidura attenuata* by M.S.U. Siddiqi, hence this species is listed as occurring in the Murree Hills in the checklist published by the Zoological Survey Department (Siddiqi, 1969). On the basis of limited evidence presently available and the preponderance of specimens assigned to this species from the eastern Himalayan regions I consider that this species probably does not occur within Pakistan territory and that all the Murree Hill population are *C. russula*.

Specimens of *C. attenuata* from other regions have a noticeably greyish-yellow wash to the ventrum, the dorsal fur being dark grey-brown. They vary in head and body length from 64–73 mm ( $2\frac{1}{2}$ – $2\frac{7}{8}$  in.) with the tail varying from 49–52 mm ( $1\frac{15}{16}$ – $2\frac{1}{16}$  in.), the hind foot averaging 13 mm ( $\frac{1}{2}$  in.) and the ear  $8\frac{1}{2}$  mm. ( $\frac{5}{16}$  in.). Two skulls labelled *C. attenuata* measured 21 mm ( $\frac{13}{16}$  in.) and 19 mm ( $\frac{3}{4}$  in.) respectively (condylobasal length). These measurements do not differ significantly from skull lengths of *C. pergrisea*.



## 5 CHIROPTERA

Pakistan has a rich fauna of bats with at least 36 species known to occur within the region covered by this book. But they are often hard to capture or locate in their roosts and even more difficult to keep alive in captivity. There is no doubt that more extensive collecting in Pakistan will reveal the presence of several more species in addition to those herein described. Our knowledge of their ecology and biology is often extremely scant and it is hoped that this chapter will indicate something of their diversity and intriguing ecological adaptations so that further studies in Pakistan may be stimulated.

Unlike the Flying Squirrels (Order Rodentia) which have the power of prolonged gliding, the Chiroptera have evolved true flight powers and are capable of sustained motion through the air as a result of flapping motions of their arms. Their wings consist of an extension of the body skin which is stretched practically without any intervening tissue over greatly elongated fingers. These digits or fingers are often longer than the forearm except for the thumb or pollex which is very short and not attached by any web of skin to the rest of the wing. Armed with a sharp claw the thumb assists the bat in clinging to surfaces. The skin of the wing is extremely elastic and when the wings are folded, shrinks to a crêpe-like texture. In some species the skin is thin and semi-transparent and liable to desiccation and damage if the bat cannot find a suitable sheltered or humid day-time roost.

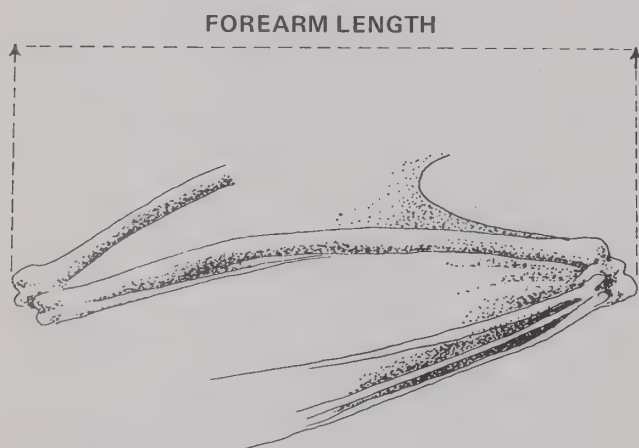


Fig. 11 Showing right wing of bat species with method of measuring forearm length. Note that the measurement includes carpal joints up to bend.

Most bats are relatively long-lived compared with other small mammals. They are usually gregarious in their roost. Many Palearctic species hibernate in winter and exhibit delayed fertilization (e.g. *Myotis* and *Pipistrellus* species) and usually the reproductive cycle is highly seasonal with females often forming separate maternal colonies at the time of parturition.

All the insectivorous bats and many fruit-eating genera have developed a highly sophisticated form of sonar or echo-location as an extra-sensory method of finding their food. Many bat species have developed fantastic shaped ear and nose-leaf appendages. It is thought that such flaps of skin

assist in channelling sound waves and perhaps assist in location of obliquely received echoes.

In one experiment (Griffin, 1959) a small *Myotis* bat was released into a completely dark enclosed room in which piano wires were strung from the floor to the ceiling, 30cm apart. The bat itself had a wing span of nearly 30cm but was able to fly around freely without collision until the room was strung with very fine wires having a diameter of only 0.07mm. It was then found that the bat collided with these wires at random and could not pinpoint the source of echo-waves received.

Reference should be made to Fig. 12 which shows the various external features of bats which often require minute comparison or examination before differentiating between species. The cartilaginous spur on the inner side of the ankle is known as the 'Calcar' and helps to support the tail flight membrane, which is known as the inter-femoral membrane or uropatagium.

The Chiroptera are broadly divided into two sub-orders, the Megachiroptera or fruit-eating bats, and the Microchiroptera or insect-eating bats.

### Key to Sub-orders of Chiroptera

- A. Inter-femoral membrane poorly developed forming a fringe along the insides of the leg with tail very short or absent. Margin of ear forming a complete ring. No tragus. Second finger with ungual phalange present and retaining degree of independence from third. Mandible with angular process broad, low or practically absent.  
... *Megachiroptera*.
- B. Inter-femoral membrane well developed, usually from heel to heel with tail usually at least as long as hind legs. Margin of ear not forming complete ring. Often with tragus. Second finger without ungual phalange and scarcely independent from third. Mandible with angular process well developed, long and narrow.  
... *Microchiroptera*.

### SUB-ORDER MEGACHIROPTERA — FRUIT EATING BATS

There is only one family the Pteropidae, within the Megachiroptera. They seek their food largely by smell and as far as it is known only one genus, *Rousettus* uses sonar (echo-location) in flight. They live mostly on soft and pulpy fruit and nectar, sucking the juices rather than swallowing any solid material. As an adaptation to this method of feeding they have developed relatively large heads with elongated muzzles and rather simple flat crowned teeth (see Fig. 14). The palate is often prominently grooved or ridged which may help in squeezing out fruit juices. Their wings are generally rather broad in outline, designed for sustained flight rather than for speed. The second phalange in the wing of this family generally comprises two joints and terminates in a claw, a useful adaptation to facilitate crawling amongst the foliage of fruit bear-

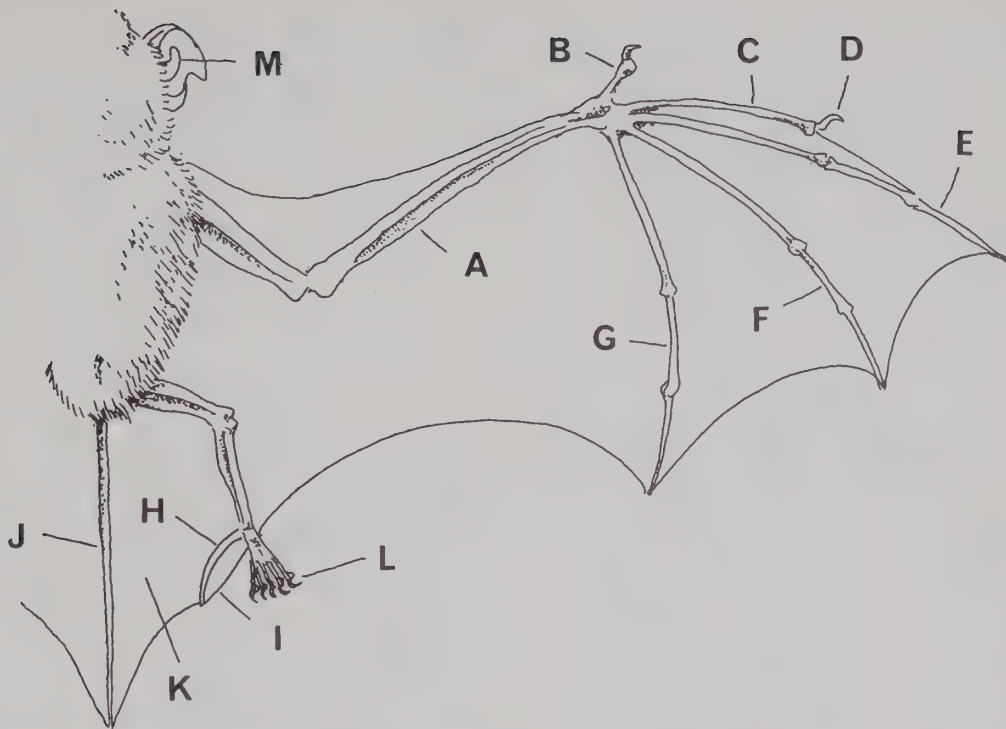


Fig. 12 Showing diagrammatic ventral view of a bat, illustrating main anatomical features of importance in differentiating between species.

- |                                    |  |                                       |   |
|------------------------------------|--|---------------------------------------|---|
| A. Forearm                         | D. Claw which is present only in <i>Megachiroptera</i> . | F. Third finger.                      | K. Interfemoral membrane or uropatagium.                            |
| B. Thumb or pollex or first digit. | E. Second finger.  | G. Fourth finger.                     | L. Right foot bearing five digits with claws curved towards viewer. |
| C. Second digit or first finger.   |  | H. Calcar or cartilaginous heel spur. | M. Tragus.  |
|                                    |  | I. Lobe.                              |   |
|                                    |  | J. Tail.                              |   |

ing trees. No species among the Microchiroptera has a claw on the second digit. The Megachiropteran inter-femoral membrane is not extensively developed in a continuous membrane as in the insect eating bats but consists of a limited narrow flap of skin along the inside of each leg (see Fig. 13). This is presumably a further ecological adaptation, enabling them while feeding to rotate one leg independently through 180 degrees in order to clasp a fruit to the breast whilst remaining suspended by the other foot from an over-hanging branch.

Fruit bats have well developed eyesight.

#### Key to the Pakistan Genera of Megachiroptera

Five upper cheek teeth. First lower molar scarcely longer than second. Medium size. Forearm 70–85 mm (see Fig. 11). Well developed claw on index finger. Distinct tail with terminal half free from inter-femoral membrane. Upper part of body uniformly coloured.

... *Rousettus*

Five upper cheek teeth. Inner mandibular incisor half size of outer. Large size. Forearm over 120mm. No tail. Well developed claw on index finger. Hind neck and shoulders markedly paler than lower back.

... *Pteropus*

Four upper cheek teeth. Crowns of molars longer than broad. Small size. Forearm 67–75mm. Distinct tail, terminal half free from inter-femoral membrane. Nostrils prominent and almost tubular.

... *Cynopterus*

#### FAMILY PTEROPIDAE — OLD WORLD FRUIT BATS, FLYING FOXES

##### Genus ROUSETTUS: Gray, 1821

##### Key to the Pakistan Species of ROUSETTUS

- (1) Pollex (thumb) 30–37.5mm long, 2nd phalange of 3rd digit 50.5–61.5mm.  
... *Rousettus aegyptiacus*
- (2) Pollex 24–30mm, 2nd phalange of 3rd digit less than 40mm.  
... *Rousettus leschenaulti*

##### ROUSETTUS AEGYPTIACUS ARABICUS

*Rousettus aegyptiacus arabicus* E. Geoffroy, 1810; Egyptian Fruit Bat.

Synonym *Rousettus arabicus* Anderson and de Winton, 1902; Arabian Fulvous Fruit Bat.

**Taxonomy:** The name *Rousettus* given to this genus is a reference to their reddish coloured body fur, and is not very apt as specimens from the dryer north western regions, as well as the Middle East, vary from a mouse-brown or isabelline-brown to grey and lack any rufescence. The latest view (Eisen-traut, 1959 and Harrison, 1964) is that *R. arabicus* should be considered no more than a sub-species of *R. aegyptiacus*.

**Description:** A medium-sized fruit bat with a comparatively large head and dog-like muzzle. There is a short vestigial



tail and the inter-femoral membrane commences from either side of this tail, consisting of two separate skin flaps extending down the hind part of the leg to the heel. The inter-femoral membrane in the region of the tail is usually fringed with hairs extending to the posterior margin (see Fig. 13). The hind feet are large with well developed claws on each of the five digits. The wings are rather broad in comparison to their length and the total wingspan is about 61cm (24in.). Besides a well-developed claw on the thumb or first digit, there is a smaller claw on the tip of the second digit. The skin of the wing and tail membranes is dark brown in contrast to the jet black skin of *Pteropus giganteus*. The body fur is short and of a rather pale straw-coloured brown varying to mouse-brown. The hair over the nape and clavicular region is a paler brown and the hairs radiate outwards. The belly fur is only slightly paler coffee-brown. In the males the penis is invaginated and inconspicuous, in contrast to *Pteropus*. They also develop glandular hair tufts in the throat region. The eyes are comparatively large (they can see well in sunlight) and the ears form small triangular conches with the outer margin meeting at the base and no tragus (see Fig. 27). When hanging vertically in its diurnal roost the head is normally carried at right angles to the rest of the body. The dental formula is, incisors 2/2, canines 1/1, premolars 3/3, and molars 2/3. The upper jaw bears two long molars at the back with three smaller premolars in front (see Fig. 14). All the molariform teeth have flattened crowns with longitudinal grooves on their surface, presumably to act as channels for draining off fruit juices. The tongue is muscular and bears backward pointing papillae near its tip whilst the upper palate bears eight prominent transverse ridges against which mouthfuls of fruit pulp can be pressed by the tongue.

Fifteen specimens from Malir, Karachi and Panjgur have the following measurements. The forearm averages 82.5mm (range 80–85mm). Head and body averages 119mm (range 105–134mm). The tail averages 17.5mm (range 14–21mm) with the free portion generally about 8–9mm (0.3–0.4in.). The first digit or pollex (measured without claw) varies from 23–26mm and the hind foot averages 20.8mm (range 19–25mm). The ear averages 23mm (range 21–24mm). Males generally weigh slightly more than the females and the external portion of the tail in males is invariably 2–3mm (0.08–0.12in.) longer than that of the females. Average weight of ten adults from Malir was 78.2g (2 $\frac{3}{4}$ oz).

**Distribution and Status:** In Pakistan *Rousettus aegyptiacus* frequents a variety of diurnal roosts from natural caves – often near the sea shore, underground irrigation tunnels (kharezes) to open wells and even inside the high vaulted ceilings of tombs. It seems to show a preference for slightly humid and darkened roosts and these are not necessarily very close to fruit gardens and food supply. It has been recorded as inhabiting caves in the sea cliffs near Clifton, Karachi (Murray, 1884) and at Lak Bidok in Las Belas (Eates, 1968). The only colonies discovered by me were down the unlined shaft of large wells such as are typically used for lift irrigation in Malir. The largest colony consisted of about thirty bats which roosted more than forty feet below ground surface. They have been recorded roosting in old tombs on the Makli Hills (Murray, 1884) but recent investigations of this area in the winter months failed to reveal any colonies. They are well adapted to live in otherwise arid and semidesert regions without much natural tree cover as long as there are suitable fruit trees within flying distance.

During World War I a good series was collected around Panjgur in the Mekran by Colonel Hotson. It apparently has



*Rousettus leschenaulti* ● Known roosts  
▨ Probable range  
*Rousettus aegyptiacus* ○ Known roosts (synonym *R. arabicus*)  
▨ Probable range

Distribution Map 8 Fulvous Fruit Bat.  
Egyptian Fruit Bat.

not extended its range anywhere north of the Mekran coastal region and southern Sind.

Extra-liminally, it extends eastwards through southern Iran, Arabia, Lebanon, Egypt and Ethiopia and in fact throughout the African continent (Lay, 1967, Harrison, 1964 and Rosevear, 1965).

In the fruit gardens of Malir this bat does some damage and is of economic importance to the farmers who occasionally drive them away from their diurnal roosts by the use of shot-guns. However they are by no means very numerous or common even in this restricted region, and must be considered rare and locally distributed in Pakistan as a whole.

**Biology:** In Pakistan this Fruit Bat, though gregarious, seems to occur in much smaller colonies than *R. leschenaulti* from northern regions. Generally colonies of 20 to 40 individuals only are found. They roost in close bodily contact, hanging characteristically in tight clusters and often in the highest darkest part of the roof of a cave, or inside an overhang at the bottom of a well, suspended freely by their hind legs. During the day they are restless in such roosts often flying from one part to another and constantly squabbling amongst themselves and emitting a high pitched pinging call. They may make seasonal migrations and abandon one favoured roost at certain seasons. Mummified remains have been found inside a grain store in Malir in March which at that time contained no bat colonies (Dr. Walton, pers. comm.).

In the environs of Karachi and Malir the principal food of this species is the ripe fruits of the Guava (*Psidium guajava*) but they feed seasonally on the nectar of Mango flowers (*Mangifera indica*) when it is in flower in March, as well as ripe dates (*Phoenix dactylifera*) in July and August (McCann, 1940B and Eates, 1968). In February they have been observed in gardens in Karachi feeding on the nectar of the Silk Cotton tree (*Salmalia malabarica*). In autumn and early winter when

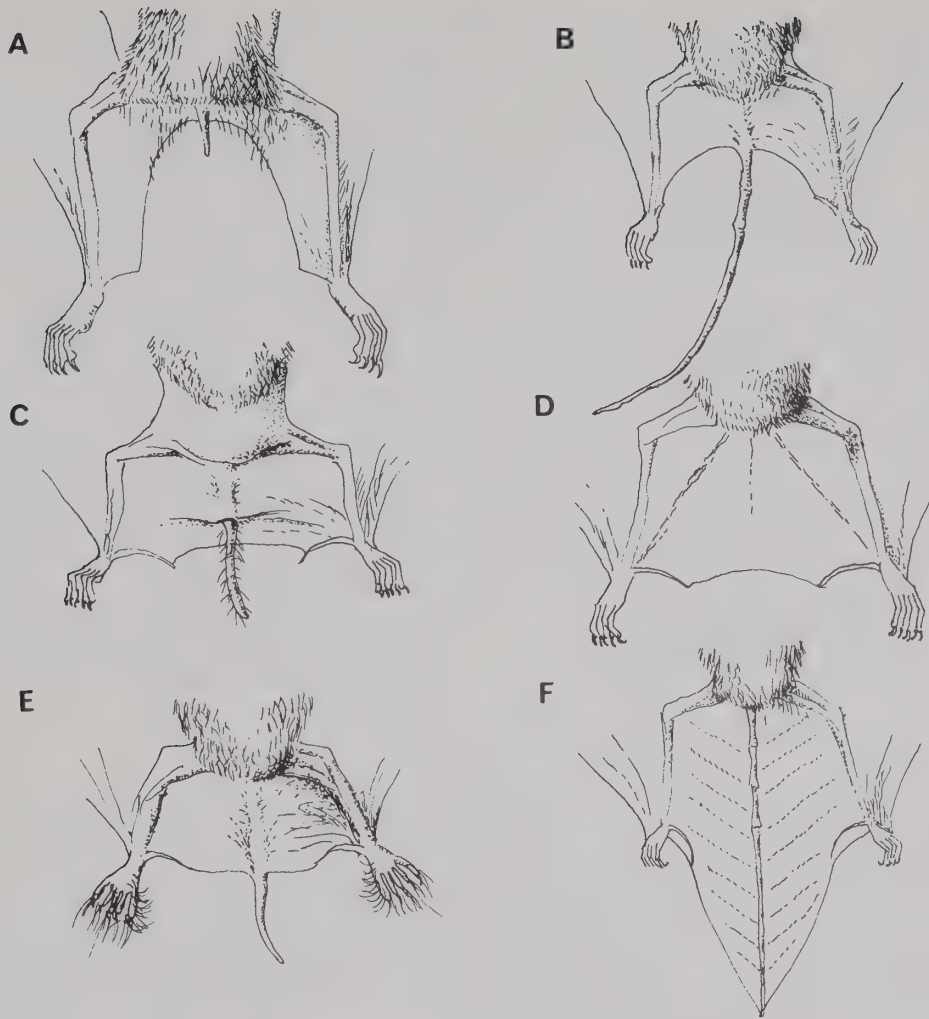


Fig. 13 Showing variations in the shapes of the interfemoral membrane as well as the tail in different families of bats. Dorsal views are shown diagrammatically and not to scale.

- |                                    |                                 |
|------------------------------------|---------------------------------|
| A. <i>Rousettus aegyptiacus</i> .  | D. <i>Megaderma lyra</i> .      |
| B. <i>Rhinopoma microphyllum</i> . | E. <i>Tadarida aegyptiaca</i> . |
| C. <i>Taphozous kachbensis</i> .   | F. <i>Eptesicus nasutus</i> .   |

other fruits are scarce they feed on the berries of the Persian Lilac (*Melia azedarach*) and the 'Neem' tree (*Melia azedarachta*), and I have watched them carrying these into the verandah of a house in Malir, dropping the drupe or seed after chewing off the pulp. They also destroy ripe bananas and papayas in Malir. In mid winter they will feed on the ripe fruits of the Pipal tree (*Ficus religiosa*) and this habit has also been noticed in the population inhabiting the Lebanon (Harrison, 1964). Observations on a colony in Malir indicate that they do not emerge from their diurnal roost to hunt until about half an hour after sunset.

Not much has been recorded about the breeding habits but it is thought the majority of young are born in the early spring with a few females producing young at the end of the monsoon season. Juvenile specimens thought to be about three months old have been trapped at Malir in the end of May. They were then about three quarters grown (total body length 109–114mm) and were flying out to feed quite independently. In Arabia females of this species were carrying suckling young at the end of March (Harrison, 1964). Studies of captive specimens indicate that the gestation period is about four months and a single young is invariably produced (Rosevear, 1965). The young are blind for the first ten days after birth but

growth is rapid and by six weeks of age the wing-span is three quarters that of the parent. The mother carries its offspring for the first five or six weeks and it does not begin to make independent flights until about nine to ten weeks old (Rosevear, op. cit.).

This bat, like other species of *Rousettus* has developed a form of sonar and is thus able to utilize darkened enclosed roosts such as underground 'Kharezes.' This undoubtedly has enabled it to colonize otherwise arid regions unsuited to the Giant Flying Fox. Its flight is comparatively slow with stiff flapping wing beats, but it is capable of travelling enormous distances each night to find suitable ripe fruit. One roost was found in the Persian Gulf, on Kishm Island which is a barren rocky islet, which however had suitable roosting caves. The nearest food supply is on the main land 20 miles away, indicating the wonderful powers of flight of this bat. It is known from studies of captive specimens that besides using echo location to navigate in dark caves, they have an acutely developed sense of smell (Eisentraut, 1959) and can detect ripe fruit from a considerable distance.

These fruit bats, in feeding, are often attracted to a tree where they hear or smell other members of the same species already feeding, and they are quite quarrelsome in the process,





Fig. 14 Showing lateral view of skulls of various Chiropteran species.

- A. *Rousettus aegyptiacus*. Note relatively long muzzle with simple flat crowned cheek teeth.  
 B. *Rhinopoma microphyllum*.  
 C. *Taphozous kachhensis*. Note strong dentition and skull with developed sagittal crest for attachment of strong jaw muscles.  
 D. *Asellia tridens*. Note relatively weak dentition.  
 E. *Pipistrellus kubli*.

often trying to snatch pieces of fruit from each other, attacking their opponent with the extended thumb, with its sharp claw. While feeding they do not actually swallow any fruit pulp, generally biting off a chunk from a fruit and crushing it after retiring to another branch for this process and then spitting out the pulp. They drink regularly after feeding and it certainly seems possible that they are able to utilize sea water as they roost in many regions where open pools of fresh or sweet water are sometimes not available. They have been observed dipping down to drink from the sea and this led to earlier assumptions that they were feeding on fish, or molluscs or floating date fruits (Dobson in Walker et al., 1964). At least one desert-adapted species, the Mexican Bat *Pizonyx vivesi* has been shown to depend upon drinking sea water (Wimsatt, 1970) and it would be worth investigating as to how the Mekran coast and Persian Gulf colonies of *R. aegyptiacus* obtain their fluid intake needs.

These bats have few natural enemies though they are usually heavily infested with ecto-parasites because of their gregarious roosting habits. Malir specimens carried wingless flies (*Nycteribidae*). It is possible that because of their comparatively slow flight they are occasionally hunted by falcons, as a Hobby (*Falco subbuteo*) has been observed hawking large bats, thought to be this species, at dusk in Las Belas (J. A. W. Anderson, pers. comm.).

#### ROUSETTUS LESCHENAUTI

*Rousettus leschenaulti* Desmarest, 1820; Fulvous Fruit Bat (see Illustration 6).

**Description:** Like the preceding species, *R. aegyptiacus*, in general appearance, it is a comparatively large bat with a large head and elongated dog-like muzzle, large eyes and broad wings.

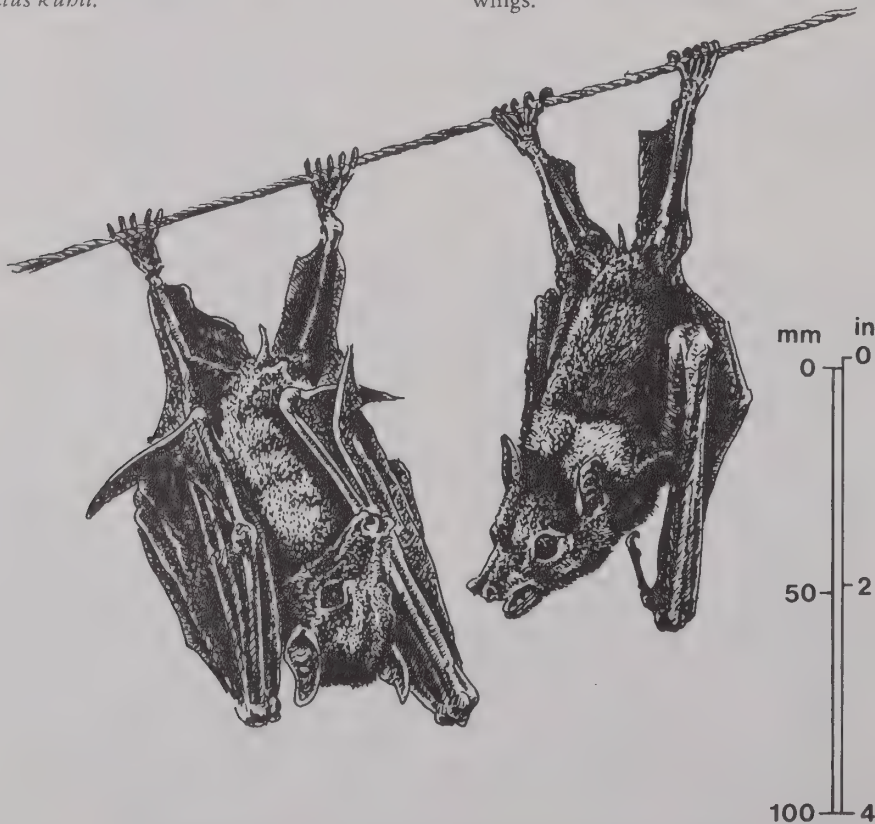


Illustration 6 *Rousettus leschenaulti*: Fulvous Fruit Bat.  
 (Based on study specimens in the University of Punjab collection from Lahore, Punjab, plus sketches from life.)

It differs however, from the Egyptian Rousette in being slightly smaller on average and in having a more rufescent tone to the dorsal fur. There is also a much more distinct collar of radiating hairs on the lower neck and shoulder region, consisting of hairs with pale bases. The body fur is short and the ventrum is a slightly paler brown. According to J. A. Brosset, this species exhibits some sexual dimorphism, the males averaging slightly bigger than the females and having the sides of their body washed with grey whereas the females are more yellowish-brown all over (Brosset, 1963, Part IV).

This bat has a well developed thumb which may measure up to 26mm (1.02in.) in length, with the claw 4mm (0.16in.). There is a small vestigial tail. A random selection of eleven specimens from the fine series from Lahore and the Malakand Pass in the Punjab University Natural History Museum had the head and body averaging 131mm (5.12in.) in length (range 120–145mm) with the forearm averaging 79mm (3.12in.) and the tail averaging 14mm (range 10–18mm) and the ear averaging 21mm (0.8in.) (range 19–23mm).

New-born young are pink and naked ventrally but the back is pigmented brown, and as their fur develops they become a dark brown almost slaty colour (McCann, 1940B). During the rut the testes of the male become enlarged and may measure 12–18mm (0.47–0.70in.) in length (McCann, op. cit.). The female has two pectorally located mammae.

**Distribution and Status:** In its diurnal biotope it is highly gregarious and in Pakistan colonies have been noted in a natural rock cave and inside the vaulted roof of a mausoleum. These roosts are generally located in the more wooded regions in the Himalayan foothill zone and adjacent plains. They are seasonally migratory and in summer season will colonize Himalayan valleys in fruit growing districts up to 1200m (4000ft) elevation. (See Distribution Map 8.)

Being partly migratory the Fulvous Fruit Bat is mainly a summer visitor to Pakistan with the exception of the known Lahore colony. It has been recorded in Azad Kashmir, Malakand, the Vale of Peshawar, Sialkot and Lahore districts. This distribution is fairly typical of other endemic oriental faunal zone species which have colonized the drier north west only in regions of greater monsoon influence.

The population of this bat does not seem large enough to have much affect on the soft fruit industry in such regions as Mardan or Peshawar but they are known to be voracious feeders and undoubtedly cause some economic loss in fruit gardens. It is curious that neither of the *Rousettus* species will touch ripe citrus fruit which is so abundant in most regions of Pakistan.

**Biology:** The Fulvous Fruit Bat, as already noted, is a highly colonial bat in its diurnal roost. In Lahore, in the tomb of Ali Murdan Khan, at Mughalpura, the colony built up to an estimated 5000 in the mid-1960s until the authorities concerned with protection of religious monuments took steps to destroy some of them. In their roost they cluster together in tight bodily contact and hang freely by their hind feet. Like *R. arabis*, they are restless during the day and frequently fly from one part of the roost to another and also keep up a high pitched pinging call. In Lahore the numbers in the colony markedly decreased in the summer months and this is believed due to their northward dispersal into fruit growing regions in the Hills. Because of their ability to use echo-location and navigate inside dark caves, they are thus able to use sheltered roosts in Himalayan regions, unsuited to the Flying Fox (*Pteropus*) which roosts only in open trees.

Z. B. Mirza discovered a colony numbering several thousands

in a rock cave at 1060m (3500ft) elevation in the Malakand. This was only a summer colony (Mirza, 1967) which corroborates their seasonally migratory movements. Another colony, in the mid-1960s was located each summer in a cave near Muzaffarabad in the Jhelum Valley of Azad Kashmir but I do not know if it is still in existence. In July, scattered individuals have also been observed roosting in Jaman trees (*Eugenia jambolana*) in Sialkot District (Mirza, 1967). As in the case of the Egyptian Rousette, the flight of this species is comparatively slow with stiff wing beats and they are believed capable of travelling very considerable distances each night in their search of ripe fruit.

In Lahore this bat has been observed in March feeding on the nectar of the Silk Cotton flowers (*Salmalia malabaricum*) as well as the ripe fruits of the Jaman in late June and early July. They have been observed entering lighted verandahs in Lahore city, to settle and consume the juices from Jaman fruit, extruding the stones and pulp onto the floor. It is known that they will also feed on the nectar of the mango when it is in flower in Bombay (McCann, 1940B). In July and August they also feed on ripe mangoes and in the Vale of Peshawar they probably feed on ripe pears in August and early September.

In Pakistan, mating is confined to a fairly restricted period from November to early December. Both males and females live in a mixed colony at this time. The period of gestation is believed to be about 15 weeks (McCann, 1941). In Bombay region it has been observed that females sometimes form separate maternal colonies though more usually even at the time of parturition mixed colonies were found (Brosset, 1962 Part I). In Lahore region the majority of young are produced from mid-February to early March (Mirza, 1967). In Bombay region the majority of young are born in mid-March (McCann, 1940B). A single young is invariably produced. These cling to their mothers in a characteristically diagonal position across the lower ventrum, firmly clasping the mother's teat in the mouth and with one foot hooked around her pelvis (see Fig. 15). The young are born with the milk teeth partially erupted to facilitate clinging onto the mother's nipple. For the first



Fig. 15 Showing ventral view female *Rousettus leschenaulti* carrying young in characteristic position.



six or seven weeks of their life, they accompany her thus when she goes out at night to feed. After this stage they become too large and heavy and from early April separate colonies of young can be seen remaining behind in the roost at night (Mirza, 1967). Though the young grow rapidly in the first few weeks of life they do not appear to make their first independent flights until they are nine to ten weeks old (McCann, 1941) and they do not attain full adult size until they are about 12 months old.

These bats have been observed by many authors (Mirza, 1967, and McCann, 1941) to be heavily infested with ectoparasites of which the most conspicuous are the bright yellow wingless streblid flies. Soft ticks (*Argus* species) mites (*Acystropus* species) were observed in the Lahore specimens, and in Bombay, besides Streblidae another winged fly *Nycteribosca gigantea*. It has also been observed that they lose or moult most of their dorsal fur in April, particularly the males. This may be partly as a result of their habit of roosting in close bodily contact (Brosset, 1962, and Mirza, 1967).

When these bats emerged from their roost on the Malakand Pass it was observed that they were 'chased by hawks' (Mirza, op. cit.).

A colony visited by me near Bombay in some temple caves at Borivili emitted a strong smell of fermenting fruit but I have not been able to detect any such smell from the Lahore colony in the winter season, probably due to different diet at that time.

#### Genus PTEROPUS Brisson, 1762

The genus contains about 35 species inhabiting the tropics from the islands of the Pacific to Australia, South East Asia and across to islands on the East Coast of Africa. It includes some of the largest bats in the world, such as the Malayan Flying Fox which has a wing span of 167.6cm (66in.).

#### Key to the Pakistan Species of PTEROPUS

Very large size with head and body over 25cm long. No tail. Forearm over 120mm and pollex 65–70mm.

... *Pteropus giganteus*

#### PTEROPUS GIGANTEUS

*Pteropus giganteus* Brünnich, 1782; Indian Flying Fox (see Illustration 7).

**Description:** The species is unmistakable, being the largest bat inhabiting the Indo-Pakistan subcontinent. Because of its habit of roosting in large open air colonies in trees, it is familiar to many people who have visited the public gardens, Bagh-i-Jinnah, in Lahore.

They are brightly coloured bats, with rufous-brown body fur around the head and neck, a conspicuous band of orange or honey coloured fur across the upper back with the fur of the lower back being dark brown, almost black. Their belly fur is dark chestnut brown overall with some blackish brown hairs in the throat region. The naked skin of the wings and uropatagium is jet black as also are the claws and the area of naked skin around the tip of its muzzle.

This bat has no tail and there is a narrow flap of skin up the inside of each hind leg. The dorsal surface of the interfemoral membrane is usually coated with dark brown hairs in the femoral region. The upper arm (Humerus) is also coated with short fuzzy rusty hairs on its dorsal surface. The thumb

is strongly developed and may measure as much as 66mm (2.6in.) and the second digit also terminates in a small claw.

The head has a long dog-like muzzle and the eyes are large with the iris dark brown. The naked black ears are small ovals. The nostrils are not raised or divided by any internarial grooves as is the tendency in *Rousettus* species. There are two thoracic mammae. The male has an external penis, and in the rut season a conspicuous naked black scrotum. Juvenile specimens are brightly coloured like the adult but slightly darker in colour.

Typical adults vary in head and body length from 250–300mm (9.7–11.7in.) (mean 26.5cm (10.44in.)), the hind foot 49–51mm (1.9–2in.) (mean 50mm (1.95in.)) and the ear 41–45mm (1.6–1.75in.) (mean 44mm (1.71in.)) and the wing span varies from 117–132.5cm (46–52in.). Adult males may weigh 1.3–1.6kg (3–3½lb) with females weighing 0.9kg (2lb).

**Distribution and Status:** They generally choose for their diurnal roost a particular large tall tree, often in a grove, and seem to prefer *Ficus* species, or the Indian Mango, both of which, with their thick foliage offer some shelter from wind and sun. Their diurnal roosts may be occupied either seasonally or throughout the year round and are invariably near



*Pteropus giganteus* ⊗ Present known roosts  
⊠ Recent occurrence

Distribution Map 9 Indian Flying Fox.

more wooded regions close to fruit gardens and orchards. Because of their open air roosting habits they are ill-adapted to extremes of temperature and in the northern regions of the Punjab they often abandon their roost during the mid winter months. However, a colony at the foot of the Margalla Hills has been observed throughout January. They are tolerant of human proximity unless directly persecuted and often establish such roosts in the environs of villages or towns.

The Flying Fox is much rarer now in Pakistan than it used to be twenty or even ten years ago, probably because orchard owners are less tolerant and there is an increasing tendency to disturb them in their roosts.

The once flourishing colony in Lahore at Bagh-i-Jinnah disappeared entirely in the winter of 1971 though it returned in

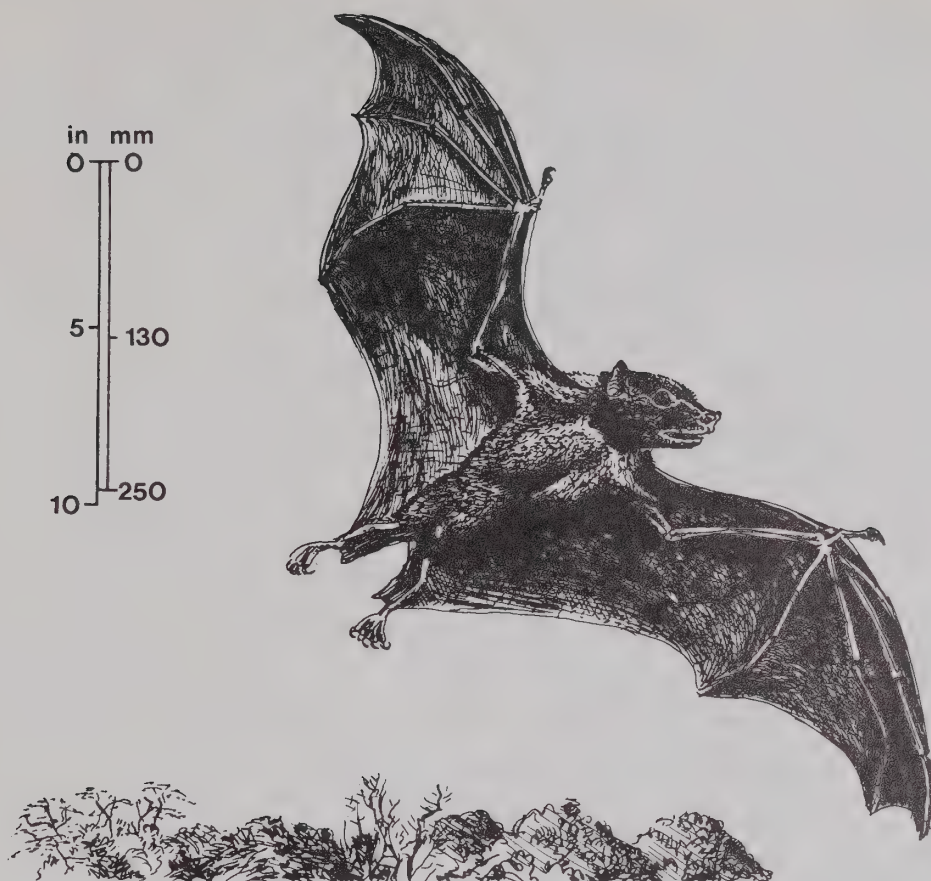


Illustration 7 *Pteropus giganteus*: Flying Fox. (Based on photographs of wild specimens in Lahore, Punjab.)

much reduced numbers in the summer of 1972. Also a small colony existed up to 1970 ten miles south of Lahore at Mohaladar Mango Gardens but has since been driven away. A small colony survived in Marala near the Canal Rest House until the late 1960s and another colony comes to Renala Khurd each year in March, remaining until the end of the monsoon. Another colony intermittently inhabits the ravine which shelters Saidpur village in the Margalla Hills.

There are no known colonies south of Renala Khurd except in the southern portion of Sind. There used to be a colony in Jacobabad and another at Shahpur in the 1950s (Eates, 1968). I remember a small colony which roosted in coconut palms at Karachi near the Clifton railway bridge in the early 1950s but these also have long since disappeared.

It is a commonly held belief that the fat from these bats is a cure for rheumatism and they are still sought after for this use by 'Hakims' or practitioners of indigenous medicine. In the summer of 1972 one individual of this species was saleable for Rs.5.00 in Lahore. It may well be that regular disturbance of such colonies around Karachi and other towns in order to secure specimens for such purposes has led to the gradual driving away of many colonies.

Flying Foxes, where numerous, can do a great deal of damage to orchards and fruit trees but they are too limited in numbers in Pakistan to be of any economic significance.

**Biology:** They are gregarious, forming colonies of 100 to 500/600 individuals. Many authors have adequately described such roosts (Jerdon, 1874, Sterndale, 1884 et al.) where they keep up a constant screaming and bickering

throughout the day with individuals frequently trying to usurp a neighbour's position and others taking wing and circling around to alight on another branch. In hot weather they show obvious distress, fanning their bodies with one half opened wing. In windy weather also they swing about wildly, unable to control their position as they hang down by their hind feet, relying solely on gravity when actually resting. They can crawl along a branch using the claws on their thumbs in a sort of quadrupedal gait. It has been observed in captivity that individual bats of this species will regularly use the same perch or branch and do not let others pre-empt their space (Proprietor, Duncan Zoo, Vancouver Island, Canada, pers. comm. 1965). They have been observed to snuffle the branches as they clamber along until they find their own roosting spot. When sleeping they tuck their heads under their wings which are wrapped around their bellies. Throughout the day many individuals in a colony appear restless and awake, spending their time in grooming their fur or scratching themselves. In late December and early January in the Lahore region they appear to be quite torpid and remain all night hanging in their diurnal tree roosts. This is probably an adaptation to the limited available food supply at that season. At this time they also hang by only one foot, keeping the other leg wrapped inside the wings, presumably to minimize heat loss.

Flying Foxes have been noted to feed on a variety of pulpy fruits and to a lesser extent upon the nectar of flowering trees, according to what is seasonally available. Thus in February they attack the flowers of the Silk Cotton Tree (*Salmaaliamalabarica*), in March the flowers of the 'Kuchnar' (*Bauchiniaalba*) and also the Mango (*Mangifera indica*). In April they will



sometimes feed on the flowers of the Sirin (*Albizzia lebbek*). In December the fruits of Pipal (*Ficus religiosa*) are an important item in the diet. In January ripe guavas (*Psidium guajava*), in June the ripe berries of Jaman (*Eugenia jambolana*) and in July ripe mangoes. In October and November they will even eat the rather dry berries of the Persian Lilac (*Melia azedarach*) and as well as wild figs such as the Pipal Tree (*Ficus religiosa*) and the Banyan (*F. indica*).

They seem able to detect food bearing trees by smell as well as by the cries (and probably smell) of their congeners. Thus, they often congregate in considerable numbers in a tree bearing ripe fruit. They have been observed to feed actively for about the first two hours of the night, then to rest, often in the same tree, until another one or two hours of active feeding before their pre-dawn return flight to the roost (McCann, 1941). Large fruits are clasped between the carpal joints of the folded wings while chunks are bitten out. Examination of the stomach contents of these bats, even just after they have been feeding, generally reveals very few traces of fruit pulp or any solid matter and their liquid diet is believed to be digested very rapidly (McCann, 1941).

In the Bombay region the rut is mainly from late August and through September (Brosset, Part I, 1962). It is possibly slightly later in Pakistan. Males in a mixed colony near Lahore observed in December had the testes still enlarged. I have observed copulation in this species in the day-time in late January in a colony ten miles south of Lahore and copulation has been observed near Bombay in October, November and in one instance on 25 January. (McCann, 1941). Possibly the breeding season is fairly extended with young being produced mainly in the spring and again during the monsoon season. The gestation period is believed to be slightly longer than for *Rousettus* species, lasting from 140 up to 150 days (Brosset, 1962). The single young is born from late February through March and at this time the testes of the males appear much regressed. In Rajasthan a colony was found to have two-week-old young in mid May (Prakash, 1960A). Observations of the entire colony in Bagh-i-Jinnah, Lahore in late April in 1970 revealed only males in the roost and it seems probably therefore that the nursing females form separate maternal colonies. However I have not been able to locate any such colony in Pakistan nor has any other observer noted separate maternal colonies. The young cling to the mother's belly and are carried thus for the first six or seven weeks of their lives.

Flying Foxes have a slow heavy flapping flight and are evidently capable of covering great distances in a single night. They have been observed to travel up to twenty miles from their known roost in one night to feed on ripe fruit (Breadow, 1931) and may well be capable of even longer nightly flights than this. Generally they do not leave their roost until half an hour or an hour after sunset, at which time all the individuals take off, one after the other, and commonly all fly away in the same general direction. They have not developed any powers of echo location and it is not surprising therefore that dead Flying Foxes are often seen in towns, entangled in overhead telephone or telegraph wires. It is believed that besides using an acutely developed sense of smell in locating ripe fruit, that they have a well developed memory as they will unerringly return to the same spot to feed, night after night, having once located a suitable tree even though this may be many miles from their diurnal roost and even if that tree be well hidden amongst other surrounding trees (McCann, 1941).

Like *Rousettus*, they are generally infested with ectoparasites, particularly the wingless flies (*Nycteribidae*) and also soft ticks. A captive specimen has lived for 17 years and another for eight years (Dover, 1933).

## Genus CYNOPTERUS F. Cuvier, 1824

### Key to the Pakistan Species of CYNOPTERUS

Forearm 67–75mm. Ears having a narrow whitish border. Nostrils clearly divergent with deep inter-narial groove. Tail 12mm.

... *Cynopterus sphinx*

### CYNOPTERUS SPHINX

*Cynopterus sphinx* Vahl, 1797; Short-nosed Fruit Bat.

**Description:** This is the smallest of the four species of Fruit Bat which occur in Pakistan. Externally similar to *Rousettus leschenaulti*, it can generally be recognized by its smaller size and more rapid wing beats when in flight. In the hand its most distinctive features are the nostrils which are situated at the tip of slightly bifurcated fleshy projections. The upper lip is also deeply grooved down the centre. Another distinctive feature is the presence of a narrow whitish border along the margin of the ears which are slightly larger in comparison to the head size than in *Rousettus*, but of the same general shape, without any tragus and having a completely enclosed tubular margin. There is a short vestigial tail as in *Rousettus* and the body fur is short and greyish-brown dorsally but with no trace of any paler collar of hairs across the upper part of the shoulders as in that genus. The belly fur is paler grey, often with yellowish tinges. The naked skin on the wings as well as the ears and around the tip of the muzzle is dark brown.

The wing span of this species is about 45.7cm (18in.) with a head and body length of 10.2–11.4cm (4–4½in.). The forearm averages about 71mm (2¾in.). There are no specimens extant from Pakistan region in the Zoological Survey collection at Karachi or the Bombay Natural History Society or British Museum collections, but Murray (1884) gives the measurements of a Karachi specimen as follows: head and body 108mm (4¼in.), tail 6.5mm (¼in.), hind foot 18mm (0.7in.), ear 25.4mm (1in.) and forearm 77mm (3 in.).

**Distribution and Status:** This is not a highly gregarious bat in its diurnal roost. Generally it is found resting in small clusters of three to four individuals during the day and these are difficult to locate as it prefers to shelter in concealed crevices either in the aerial roots of the *Ficus* tree, or between the folds of dead palm fronds in coconut trees or even bananas.

This seems to be a typically oriental faunal zone species confined to warmer sub-tropical zones in areas where there are large numbers of flowering and fruiting trees.

The short-nosed fruit bat was described by J. A. Murray and K. R. Eates as being quite plentiful in Karachi and Malir (Murray, 1884, and Eates, 1968) but no specimens seem to have been collected recently either by the Zoological Survey of Pakistan or by the Bombay Natural History Society during its mammal survey of southern Sind. According to farmers in the Malir area a small fruit bat does occur which attacks the 'chiku' fruit (*Achras sapota*), as well as the Custard Apple (*Anona squamosa*) hovering near the ground, and it seems probable that this is *Cynopterus*.

Until more evidence is available it must be regarded as uncommon and certainly very restricted in distribution being confined to the environs of Karachi and Malir. With the spread of banana cultivation in recent decades up to Hyderabad, it is however, likely that this bat has followed as far north as that city.



Distribution Map 10 Short Nosed Fruit Bat.

It has been suggested that this species may be beneficial as an agent in seed dispersal (feeding on ripe dates and dropping the pits some distance from the food tree) (McCann, 1940A), and also in pollinating flowers which produce nectar at night. It is probably not numerous enough in Pakistan to do any significant damage to the fruit crops.

**Biology:** Not being highly gregarious and choosing concealed places for its roost, the presence of this bat is difficult to detect. They are nocturnal in feeding activity and, like most of the fruit bats, voracious feeders. There have been more observations of their activities in the Bombay region where they are comparatively common and it is known that there they feed on ripe guavas (*Psidium guajava*), bananas, liches (*Nephelium litchi*) and 'chikus' (*Achras sapota*) (McCann, 1940B). It is very fond of 'chikus' (the Sapodilla Plum) and this is probably its main food in the environs of Karachi. All the above fruits are important orchard crops in Malir, where this bat has been seen. They have an acutely developed sense of smell which enables them to locate ripe fruit and there have been authentic instances of this bat entering rooms and stealing ripe fruits from kitchen and pantry shelves which they could only have detected by smell (Brosset, Part I, 1962). Unlike the larger fruit bats they seem more agile on the wing and can feed without alighting, on the nectar of flowers or fruits borne on comparatively low bushes (such as 'chikus'). They are also able to hover with swift wing beats in front of flowers (Brosset, 1962). When feeding on large kinds of fruit they generally fly away with the whole fruit held in their mouth, settling high up on a nearby tree where they then crush and suck the fruit (McCann, 1941). They are believed to be very greedy feeders capable of eating more than their own weight in fruit within the space of one night (Eates, 1968).

Nothing is known about the breeding biology of this bat around Karachi, but around Bombay the rut appears to be in September and October with the majority of young then being born after a gestation period of 115 to 125 days (Brosset, op cit.). In other parts of India young have been

collected in July as well as September (in south India) (Prater, 1965). Around Bombay young individuals observed in early summer indicated parturition in early spring. Also males captured in early August had the testes regressed and were not sexually active (McCann, 1941). It seems likely therefore that this species has a spring as well as post monsoon rut. Like other fruit bats, the young are carried by the mother on her nightly flights until quite large. Characteristically they cling across the mother's ventrum with the main axis of their body being almost along one flank and the mouth firmly clasping the mother's nipple.

Short-nosed Fruit Bats often emerge well before darkness to start feeding — earlier than the other fruit bats. They are silent if detected in their diurnal roost in sharp contrast to the *Rousettus* fruit bats. They are heavily infested with external parasites (Brosset, op cit.).

#### SUB-ORDER MICROCHIROPTERA INSECTIVOROUS BATS

The second broad sub-division, called Microchiroptera meaning literally 'small hand wings', comprise all the insect-eating bats. The Microchiroptera are a more diverse sub-order than the Megachiroptera or Fruit-eating Bats and some species weigh up to 22.8g (8oz) and have a wing span exceeding the smaller Megachiroptera. For example, several species of *Tapozous* Bats (Sheath-tailed Bats, of which one occurs in Pakistan) are bigger than the Blossom Bats. *Syconycteris australis*, a megachiropteran found in Western Australia, rarely exceeds 15g (0.5oz) in weight and 25cm (10in.) total wing span.

Insect-eating bats comprise sixteen families, some of which, such as the Rhinolophidae, are very large and diverse (with over 150 different named forms). They are not confined to the tropics and sub-tropics as are the Megachiroptera and have been able to spread into temperate zones to take advantage of the abundant insect life in such latitudes during the summer months. Most of the Palearctic species hibernate during the winter.

The sharply-cusped teeth of insectivorous bats are highly efficient tools in grinding up the hard chitin exoskeleton of insects. Even in flight these bats can grind up the shells of quite large insects into tiny particles. This makes it particularly difficult to identify any insect species eaten by bats, from examination of stomach contents.

#### Key to the Pakistan Genera of Microchiroptera (See Fig. 13.)

- A. Tail wholly or partly free of inter-femoral membrane. . . . 1.
- B. Tail absent or almost wholly enclosed with inter-femoral membrane. . . . 2.
- 1(c) With long rat-like tail and hardly any inter-femoral membrane. . . . *Rhinopoma*
- (d) Extensive inter-femoral membrane which encloses basal part of tail but distal portion lying free in middle of membrane. . . . *Tapozous*
- (e) With thick tails which project well beyond a short inter-femoral membrane. Lips of mouth bearing deep vertical folds. . . . *Tadarida*



- 2(a) Without any tail. Elongated noseleaf and large rounded ears joined across forecrown.  
... *Megaderma*
- (b) With tail equal to or longer than hind leg and wholly enclosed by inter-femoral membrane. Having a conspicuous noseleaf.  
... 3.
- (c) As above and no noseleaf.  
... 4.
- 3(d) With ears pointed and outer margin concave at tip. No tragus. Elaborate noseleaf including a horse shoe shaped disc situated anteriorly and surrounding the nostrils and posterior portion terminating in slender pointed projection.  
... *Rhinolophus*
- (e) With ears as in (d) but posterior portion of noseleaf rounded and without projections and arcuate when seen in profile.  
... *Hipposideros*
- (f) With posterior portion of noseleaf having three pointed projections on its upper edge. Tip of tail extending slightly beyond inter-femoral membrane.  
... *Asellia*
- 4(a) With one pair of upper incisors.  
... 5.
- (b) With two pairs of upper incisors.  
... 6.
- 5(c) With only four cheek teeth in maxillary tooth row and ear about one-third forearm length.  
... *Nycticeius*
- (d) With only four cheek teeth in Maxillary tooth row  
Prominent oval ears two-thirds the length of forearm.  
... *Otonycteris*
- (e) With five cheek teeth in maxillary tooth row and occipital region of skull with helmet-like projection.  
... *Scotophilus*
- 6(f) With only four cheek teeth in maxillary tooth row  
Tragus small and not sharp pointed.  
... *Eptesicus*
- (g) With five cheek teeth in maxillary tooth row.  
... 7.
- (h) With six cheek teeth in maxillary tooth row. Tragus rather slender and sharply pointed.  
... *Myotis*
- 7(i) With nostrils prominent and tubular. Inter-femoral membrane hairy.  
... *Murina*
- (j) Nostrils not tubular and very large oval ears equal to head and body length.  
... *Plecotus*
- (k) Nostrils not tubular and ears not very large.  
... 8.
- 8(a) Ears broad and rounded and joined at base of inner margin and across forehead. Tragus triangular. Dorsal fur blackish.  
... *Barbastella*
- (b) Ears widely separated from each other. Tragus expanded distally and club shaped. Fifth finger short, being less in length than first two phalanges (joints) of 4th digit.  
... *Nyctalus*

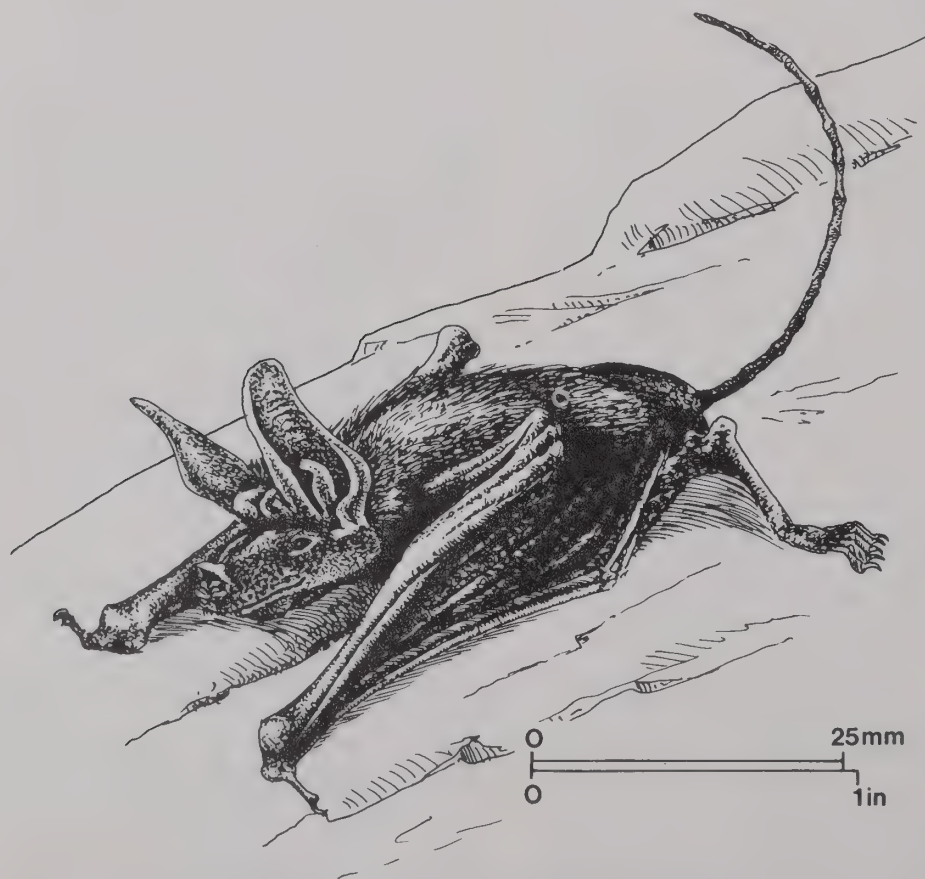


Illustration 8 *Rhinopoma microphyllum*: Greater Mouse-tailed Bat. (Based on live captive specimens from Qutabpur, Punjab.)

- (c) Tragus slender and forward curving. Second phalange (last joint) of 3rd digit about three times as long as 1st phalange.

... *Miniopterus*

- (d) Tragus slender and forward curving. Fifth digit longer than first two joints of 4th digit. First pre-molar usually minute and set behind the canine with second pre-molar almost equal in size to 3 molars.

... *Pipistrellus*

#### FAMILY RHINOPOMATIDAE – MOUSE-TAILED BATS

##### Genus RHINOPOMA: Geoffroy, 1818

This genus comprises but two species according to the latest taxonomic view (Rosevear, 1965), and these occur from North Africa through the Middle East to South East Asia. The generic name has reference to the peculiar shape of the valvular nostrils and is derived from the Greek words meaning 'lid-nose'.

##### Key to the Pakistan Species of RHINOPOMA

- (i) Forearm 60–72mm long, tail 48–62mm and generally shorter than forearm.  
... *Rhinopoma microphyllum*
- (ii) Forearm 46–60mm long and tail 55–71mm and generally longer than forearm.  
... *Rhinopoma hardwickei*

##### RHINOPOMA MICROPHYLLUM

*Rhinopoma microphyllum* Brünnich, 1782; Larger Rat-tailed Bat or Mouse-tailed Bat (see Illustration 8).

Synonym *Rhinopoma kinneari* Wroughton, 1912.

**Taxonomy:** Recent studies have provided convincing evidence that *R. kinneari* originally collected from the Rann of Kutch by the Bombay Natural History Mammal Survey, is conspecific with *R. microphyllum* (Allen, 1959 and Felten, 1962).

**Description:** This is a medium-sized bat which can immediately be recognized from among all other Microchiroptera by the very long slender tail which is completely free of the inter-femoral membrane (see Fig. 13). The tail is roughly equal to the head and body length and Brosset (1962, Part I) states that in the field it can be separated from *R. hardwickei* by having an apparently shorter and thicker tail. Specimens seen by me in the Punjab appeared to have equally slender tails in the field and this feature did not seem helpful in separating *R. microphyllum*.

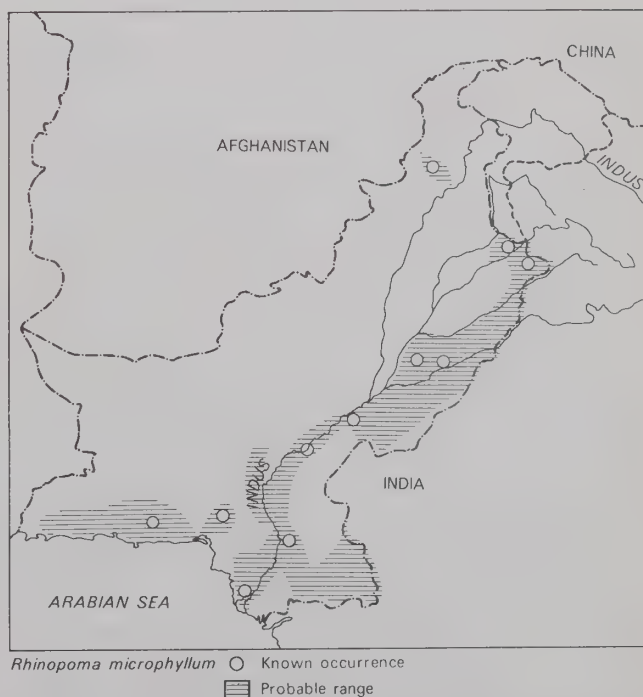
The muzzle is long snout-shaped and naked, with the lower jaw appearing shorter than the snout. It has comparatively large bright eyes. They are in fact quite tolerant of bright light in their roosting places. The tip of the nose bears a small fleshy triangular projection, below which the valvular nostrils appear as diagonal slits. The ears are large and conspicuous and roughly rhomboidal in shape. They are united across the forehead by a peculiar fleshy ridge. The conspicuous tragus curves forward and is lunate in shape, and if examined under a magnifying glass can be seen to be multi-lobate at the tip. The outer

ear margin develops a small anti-tragus. The body fur is of medium length, close and silky and in Pakistan specimens, invariably of a greyish-brown colour with the belly fur a slightly paler grey colour. Specimens from other parts of India are described as being quite variable in colour with some individuals having a rufescent tinge. In the pelvic region both dorsally and ventrally the skin is naked and at the end of the monsoon season, in Pakistan, these bats often have huge deposits of fat around the base of the tail, which shows through the skin as a yellowish sheen. The tail is generally carried in an upward curving arc when they are at rest and they give the general impression of being rather slender bats with a flattened body.

The wings are also a rather unusual shape, the forearm being comparatively long whilst the phalanges are short. The wing thus looks bluntly rounded in shape. There is often a thin whitish margin on the posterior margin of the wing.

Out of six specimens from the Punjab, the head and body varied from 74–90mm (2.9–3.55in.), (the mean 81mm (3.2in.)), the tail from 46–55mm (1.8–2.15in.) (mean 50mm (1.98in.)), the hind foot 15–16mm (0.59–0.62in.) (mean 15.5mm (0.6in.)) and the ear 19–22mm (0.75–0.85in.) (mean 20.5mm (0.8in.)). This bat has a longer forearm than the Lesser Rat-tailed Bat though there is otherwise often much over-lapping in their body sizes. Thus *R. microphyllum* has the forearm varying from 61–71mm (2.35–2.78in.) (mean 68mm (2.6in.)). An adult specimen, which was not fat, collected in early November from Mailsi, weighed 14g (0.5oz). There is some sexual dimorphism in this species, the males averaging 2–3mm (0.1–0.12in.) greater in head and body length (Gaisler, 1970).

**Distribution and Status:** This bat seems to be adapted to the dryer semi-arid regions of the country and to be well able to withstand very high summer temperatures in its diurnal roost. They have been found roosting inside unlighted deserted buildings as well as in old tombs and underground cellars of an old fort, and natural rock caves.



Distribution Map 11 Larger Mouse-tailed or Rat-tailed Bat.



*R. microphyllum* is much more numerous than *R. hardwickei* throughout the northern regions of the Indus plain. It appears, however, to be rather locally or erratically distributed and this may be the result of its gregarious roosting habits and the location of suitable or favoured roosting places. Colonies have been found near Jhelum, Gujrat, Multan and Mailsi in the Punjab. In Sind, colonies have been found in Hyderabad, Sukkur, the Karchat Hills and Karachi. I have found a small colony in Sadikabad and Z. B. Mirza found a large summer colony inhabiting a natural rock cave in the Malakand Hills (Mirza, pers. comm.). They do not appear as plentiful as the Sheath-tailed Bats though they are well adapted to arid semi-desert regions.

In India it does not occur south of Bombay and seems to be more numerous in the north central plains, especially Uttar Pradesh. (Brosset, 1962, Part II). It is not uncommon in summer in southern Afghanistan (Gaisler, 1970) but appears rare in Iran (Lay, 1967). It extends westwards to Arabia, where it is rare, and also in the Sudan and Egypt.

**Biology:** This is a highly gregarious species in its roost, generally clinging by the hind feet and thumbs to the sides of the wall in a natural rock cave, down an open well, inside old tombs or in deserted buildings. Colonies of up to 500 or 600 individuals have been found together in the southwest Punjab by me and in India colonies numbering over 1000 have been recorded (Brosset, Part I, op cit.). They are highly tolerant of noise in the roost and even to some extent other disturbance, though they are very agile and will run across a vertical wall into available crevices when approached. A strong and unpleasantly characteristic smell emanates from these bats in the roost and this readily reveals their presence to the human intruders. They are also quarrelsome and noisy and their incessant high pitched squeaking is to me reminiscent of the sound made by the seat springs of an old car as it bumps along. When disturbed they wag their slender tails rapidly to and fro in a pendulum motion and this seems to indicate nervousness.

As might be expected from their wing shape, this species is not a very swift flyer though it flies with very rapid wing beats usually interspersed with steady glides. Captive specimens released at dusk circled until flying quite high and their shallow wing beats were frequently interrupted by glides. The thin tail can clearly be discerned trailing out behind as this bat flies overhead. Other observers have noted that their flight seems to have a rising and falling trajectory and that they probably do not hunt far from their roost (D. L. Harrison, 1964 and Brosset, 1962 Part II). Examination of stomach contents indicates that they feed mostly on smaller insects such as Diptera and this is borne out by their comparatively weak dentition (Brosset, op cit.) (see Fig. 14, also).

Despite being so numerous in various parts of northern India remarkably little is known about the ecology of this bat. In his studies at Fatehpur Sikhri in north central India, A. Brosset observed sexual activity in early April and thought that parturition was in June though one female dissected in early April had a discernible foetus (Brosset, 1962, Part I). At this time the colony consisted of mixed sexes.

In the south west Punjab I have been able to observe several colonies of this bat over a period of years, which has revealed several facts which contradict A. Brosset's observations in central India. Besides being highly colonial in their roost, the two sexes occupy separate roosts over the entire summer and autumn period. Furthermore they are migratory and leave the region from about mid October until the middle of May. In one colony in Qutabpur all the females arrived between 18 May and 29 May, numbering some 600 individuals.

This colony was located in a semi-dark underground cellar of a deserted cotton ginning factory. The following year the females also arrived around 20 to 22 May. In both years they were in an advanced state of pregnancy at this time and the first young were observed from the last week of June until about 8 July when all the females appeared to be carrying young. This slightly later time of parturition corresponds with observations in Rajasthan (India) when *R. microphyllum* was observed carrying young in August (Prakash, 1960A). Only one young is produced and this is firmly attached to the mother's belly in an inverse position attached to one of the false teats which are situated inguinally. At birth the young are naked and of a pinkish-grey colour. They grow rapidly and within one month are almost half the size of the mother. After they are about eight weeks of age they remain behind at night in the roost.

In Qutabpur the male colony arrived a few days after the females and in one year established itself under some overhead galvanized iron water tanks situated at a distance of about one furlong (201m) from the maternal colony. It was impossible to estimate the numbers in this roost due to its inaccessibility but they were in hundreds.

All known colonies in the Multan region suddenly disappear about the middle of October, though a few individuals may linger on until the end of October. It is not known to where they migrate, but they probably seek a more sheltered roost and enter a relatively torpid period for the rest of the winter during which fat re-absorption from the pelvic region probably takes place. A. Brosset (1962) found no physiological evidence that this species hibernates. This is corroborated by the discovery of an active (though weak) individual on 31 December in Iran (Lay, 1967). In Afghanistan this species also appeared to be migratory, coming into the Jalalabad region in early April (Gaisler, 1970). In the Punjab and Bahawalpur regions fat accumulation is noticeable in this bat at the end of the monsoon season and this would suggest that they may not necessarily migrate to warmer latitudes in the winter but can subsist upon their own accumulated reserves once they have found a more sheltered and protected roosting site.

## RHINOPOMA HARDWICKEI

*Rhinopoma hardwickei* Gray, 1831; Lesser Rat-tailed Bat or Small Mouse-tailed Bat.

(*Rhinopoma sumatrae* is now considered a very large subspecies of *R. hardwickei*.)

**Description:** Closely similar to *R. microphyllum* in external appearance, this bat is on average slightly smaller and lighter in build with a comparatively longer and more slender tail and much shorter forearm. The forearm in this species rarely exceeds 60mm (2.38in.) to 67mm (2.6in.) in length. The body fur also tends to be more rufescent brown dorsally in specimens from the Salt Range. In all other respects it closely resembles *R. microphyllum*. Average of nine specimens from Sind and the northern Punjab, head and body length was 62mm (range 55–69mm) with the tail averaging 67mm (range 57–77mm) and the hind foot averaging 11.5mm (range 9–15mm) with the ear averaging 18mm (range 16–20mm) and the forearm averaging 60mm.

As in *R. microphyllum* besides two pectoral teats there are two false teats situated inguinally in the females. The second digit has two phalanges.

**Distribution and Status:** This species regularly occurs in the same diurnal roosts as *R. microphyllum* and thus will in-



*Rhinopoma hardwickei* ○ Known occurrence  
▨ Probable range

Distribution Map 12 Lesser Mouse-tailed or Rat-tailed Bat.

habit a variety of natural caves, man-made cellars, dungeons and 'kharezes' (underground irrigation tunnels). They seem well adapted to semi-desert regions and are confined to sub-tropical latitudes.

Specimens have been collected from Rohtas in the Salt Range and around Karachi and Landhi in southern Sind. In Landhi they roosted at the bottom of a deep open well. A small colony was found in March 1973 in a natural rock cave in the Karchat Hills near Hyderabad (Dr. Holloway in lit.).

In Pakistan this species is much less common than *R. microphyllum*, a quite contrary situation to that prevailing both in the near East (D. L. Harrison, 1964) and Iran (Lay, 1967).

In the Indian sub-continent they are absent from forested areas such as the Ghats, being most common in northern central regions. It is widespread and common in Arabia, Eritrea, the Sudan and Egypt. It occurs seasonally around Jalalabad in Afghanistan where it is much less numerous than *R. microphyllum* (Gaisler, 1970). It also occurs in Burma, Thailand and Indonesia.

**Biology:** The Lesser Mouse-tailed Bat is not so colonial in its diurnal roost as *R. microphyllum* preferring to roost in small clusters of 20 to 30 individuals. In the winter, at least, both sexes apparently roost together (Lay, 1967) but after the rut and until the late autumn both sexes apparently occupy separate roosts (Brosset, Part I, 1962). Observations in the Deccan showed that there are often numerous separate but closely proximate colonies of this bat, indicating that it might be more sociable than the small size of the individual colonies at first suggests (Brosset, 1962). They are also quite tolerant of the proximity of other bat species in their roost as well as of human disturbance provided they are not molested.

Little has been recorded about its breeding biology, but as in *R. microphyllum* there appears to be marked periodicity of the rut, with the young being born in June, and the young being carried by their mothers in an inverted position (Reuben, 1963). The false teats are enlarged and conspicuous even in non-parous females.

Fat re-absorption probably occurs in this species as there is considerable accumulation observable at the end of the monsoon in October, mainly in the region of the inter-femoral membrane and base of the tail (Brosset, 1962). In Afghanistan there was evidence of seasonal migration (Gaisler, 1970). There is no evidence that this species hibernates though it obviously undergoes prolonged periods of inactivity in the winter. In eastern Iran colonies were found in November and January in cool dry caves and though active when disturbed they were not hunting at night during this season (Lay, 1967).

As with *R. microphyllum* the wing is bluntly rounded and flight comparatively slow and weak and they are believed to feed mainly on smaller dipterous insects.

## FAMILY EMBALLONURIDAE – SHEATH-TAILED BATS, SAC-WINGED BATS

### Genus TAPHOZOUS<sup>11</sup> Geoffroy, 1818

#### Key to the Pakistan Species of TAPHOZOUS

- (i) Medium size, forearm 59 to 63mm, dorsal fur pale-greyish buff. Males with inconspicuous gular pouch gland 6mm wide across mouth. Throat gland absent or vestigial in females.  
... *Taphozous perforatus*
- (ii) Large size, forearm 70–73mm, dorsal fur dark grey-brown. Males with conspicuous gular pouch or throat gland 10–11mm wide across opening (see Fig. 16). Females with smaller clearly visible gular pouch.  
... *Taphozous kachhensis*

#### SUBGENUS *Taphozous* Geoffroy, 1818

#### TAPHOZOUS PERFORATUS

*Taphozous perforatus* Geoffroy, 1818; Tomb Bat, or Egyptian Tomb Bat.

**Description:** This is one of the smaller species of Sheath-tail and it is mainly distinguished in the field by having the body both dorsally and ventrally well covered with fur down to the root of the tail. The distal half of the tail emerges about mid-way dorsally through the interfemoral membrane (see Fig. 13) and is rather more slender than the tail of other *Taphozous* species. As is characteristic of most of the genus (*T. saccolaimus* being the single exception) there is a radio-metacarpal pouch and traces of a gular-pouch or crescentic throat gland (see Fig. 16). The wings are long and narrow and the tips are beautifully and intricately folded inwards when the bat is at rest (see Fig. 18). *Taphozous* have doglike heads with no noseleaf, the tip of the muzzle being rather square cut when viewed laterally. The eye is comparatively large and they are quite tolerant of bright light in their diurnal roosting place. The widely-separated ears are set low down on either side of the crown and are triangular in outline with about ten transverse ridges inside the ear conch. The anterior margin of the ear is papillate and there is a conspicuous mushroom shaped tragus (see Fig. 16). Compared with the other species of *Taphozous* the gular sac is vestigial and hard to see on males, consisting only of a small crescentic mark about 5–6mm (0.2–0.26in.) wide and sometimes entirely absent in females. The free portion of the tail bears a scattering of long white hairs. The hind feet are comparatively large and there is a



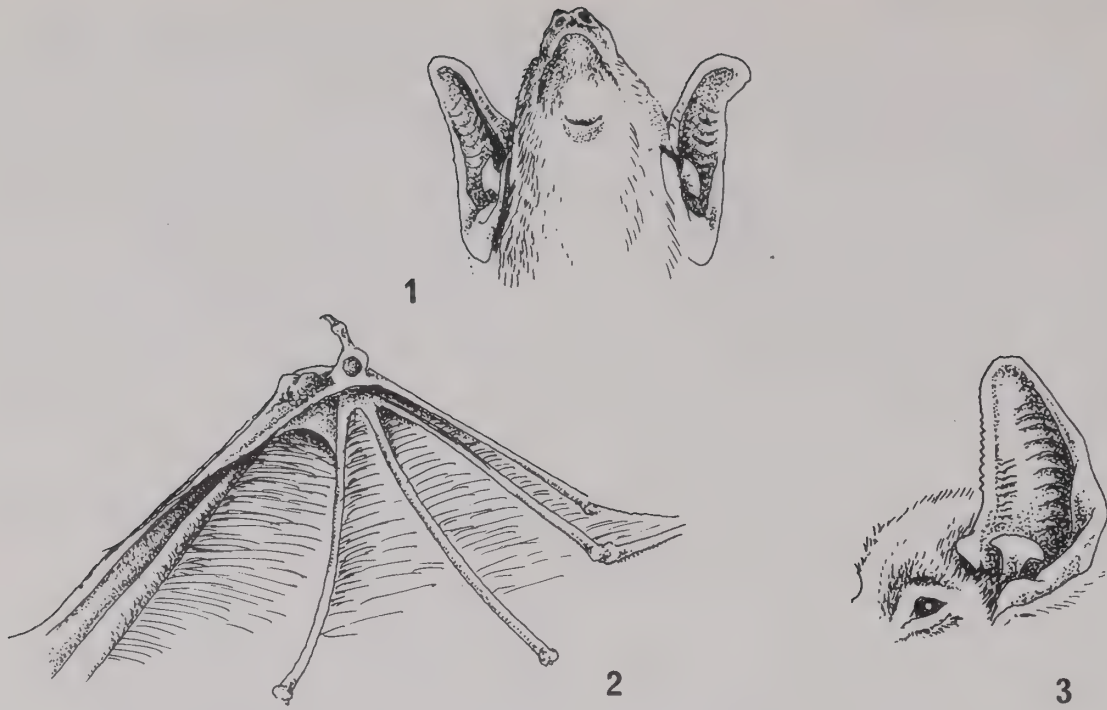


Fig. 16 Showing distinctive features of *Taphozous* species in Pakistan.

1. Ventral view of head showing gular throat sack gland.

2. Ventral view of right wing showing radio-metacarpal pouch or pocket of skin between the forearm and fifth phalange, also round pad at base of thumb.

3. Ear showing tragus and small anti-tragus beneath.

strong calcar or heel spur. On the ventral surface of the wing a small round meta-carpal disc occurs (see Fig. 16). This no doubt assists the species in crawling over vertical walls and surfaces and it is comparatively agile in its diurnal roost. There is also a similar small callosity on the heel of the hind foot. It is not known what function, if any, is fulfilled by the presence of the radio-metacarpal pouch which is formed by a small flap of skin stretched between the fifth digit and the forearm (radius).

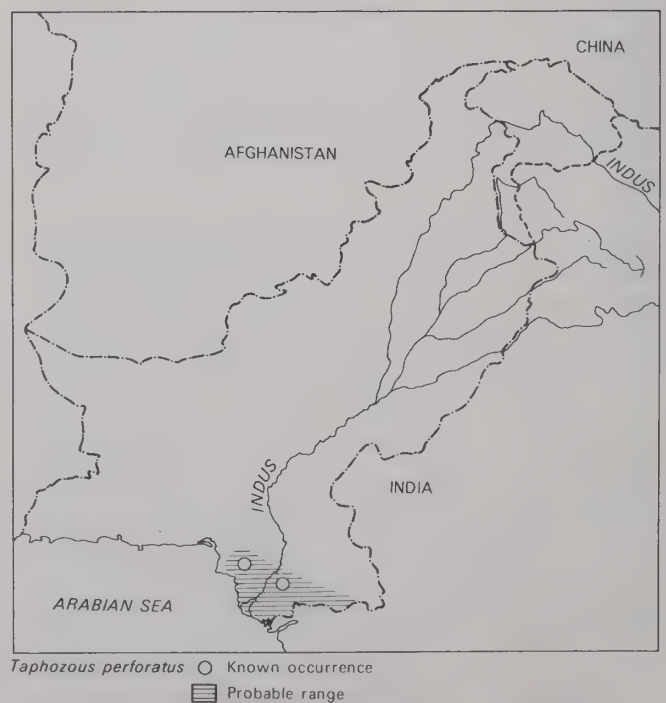
Specimens from Pakistan have short, close greyish-brown fur being only slightly paler ventrally. The hairs over the clavicular region tend to average longer and to have paler bases. The forearm varies from 59–63mm (2.30–2.45in.) and the average of ten specimens from Jatti in Sind was 62.3mm (2.43in.) with the tail 21–27mm (0.8–1.05in.). The hind foot averages about 11.5mm (0.48in.) and the ear about 18mm (0.7in.).

**Distribution and Status:** This is a gregarious species in its diurnal roost and also noticeably noisy when disturbed. They are adapted to regions of low rainfall and semi-desert. In their choice of roost they seem to be quite eclectic, inhabiting natural caves as well as all kinds of man-made structures including inhabited dwellings in parts of Kathiawar in India (Brosset, 1962, part II). In Pakistan they have been found in old tombs as well as down open wells but in all cases they conceal themselves in crevices between bricks and rock fissures and do not roost clinging to an open wall surface like the other *Taphozous* species found in Pakistan.

In Pakistan they seem uncommon and limited in distribution, having been collected only by the Zoological Survey of Pakistan from Jatti in Thatta District in southern Sind (Siddiqi, 1961). They have not been recorded elsewhere in northern Sind or the Punjab. They also occur in Kutch, Kathiawar and Ahmedabad districts of western India, but

have not been recorded elsewhere in the subcontinent. Several subspecies of *T. perforatus* occur in the Middle East, Egypt, Sudan, Kenya, Tanzania and Nigeria.

They appear very tolerant of other species in their roost and have been collected with *T. kachbensis* in Kutch (Brosset, op cit.) and with *Rousettus aegyptiacus* in the Middle East (D. L. Harrison, 1964).



Distribution Map 13 Tomb Bat or Egyptian Tomb Bat.

**Biology:** Despite being so tolerant of human disturbance and frequently choosing occupied buildings for its roost, this bat is very shy and will not allow close approach.

Their long slender wings enable them to fly very swiftly and strongly and they are believed to hunt over an extensive territory, often at considerable distance from their roost. They apparently do not return to their roost during the night and little is known about their feeding or hunting habits.

As far as is known, both sexes share the same roost and there is no segregation. There seems to be marked periodicity of the rut. The only records of breeding is from Kathiawar where young were observed born in early May (Brosset, op cit.).

Fat accumulation has been observed in this species, becoming particularly noticeable by the end of the monsoon season (late September, early October). Presumably they have inactive periods in winter, but no true hibernation as with most tropical bat species.

SUBGENUS *Liponycteris* Thomas, 1922

### TAPHOZOUS KACHHENSIS

*Taphozous kachhensis* Dobson, 1872; Kutch Sheath-tailed Bat (see Illustration 9).

**Taxonomy:** Due to its larger size and distinctly stronger dentition (see Fig. 14), this sheath-tailed bat was placed in a separate subgenus when first discovered in north west India. It is closely related to *T. saccolaimus* and Ellerman and

Morrison-Scott (1951) included Malaya, Burma and Sikkim in the distribution of *T. kachhensis* whereas this southeast Asian population is now assigned to *T. saccolaimus* (Medway, 1969). *T. nudiventris*, originally described from Egypt, is a similar large dark sheath-tail with a well developed gular throat pouch. Recent collection of material from Iran and Afghanistan has shown the very close relationship between these populations and the latest view (Felten, 1962) is now that *T. kachhensis* is but a subspecies of *T. nudiventris*.

**Description:** This is a very large sheath-tailed bat having body fur of a dark blackish-grey without any clavicular collar of paler hairs as born by *T. perforatus*.

The body fur is short and silky and the ventral fur a paler greyish-white. Unlike the subspecies of *T. nudiventris* inhabiting regions further west, *T. kachhensis* has the dorsal fur extending almost right down to the base of the tail so that the trivial name 'naked-bellied' is misleading if applied to *T. kachhensis*. Furthermore the throat pouch is well developed in adult males, consisting of a crescentic flap of skin about 10–11mm (0.38–0.43in.) wide across its orifice. A crescentic mark is also clearly visible in adult female specimens. In other respects it is a typical sheath-tail with a rather dog-like face, long semi-naked muzzle, no noseleaf, comparatively large eyes and widely spaced triangular ears. The inner margin of the ear is papillate and there is an anti-tragus with the tragus being short and shaped like the blade of an axe (see Fig. 16). The posterior margin of the tragus bears a lobe or slight projection at its base which is not found in *T. perforatus*. This species



Illustration 9 *Taphozous nudiventris kachhensis*: Naked-bellied Sheath-tailed Bat. (Based on live captive specimens from Sadikabad, Bahawalpur Division.)



has frequently been observed to fold back its ears when at rest.

The average dimension of 13 specimens from the Punjab and Sind provinces was 71mm (2.8in.) forearm, with the head and body length 92mm (3.6 in.) (range 86–98mm) the tail 36.5mm (1.46in.) (range 34–42mm), the hind foot 14mm (0.55in.) (range 11–18mm) and the ear 22mm (0.88in.) (range 19–23mm).

**Distribution and Status:** This is a common and widespread species throughout the Indus plain and up to the Salt Range but it has not been recorded in the mountainous areas of Baluchistan or the North West Frontier Province. Specimens have been collected from Multan District, the Salt Range, Bahawalpur and throughout Sind from Sukkur and Khairpur in the north to Jacobabad and Thatta Districts in the south.

*T. kachhensis* occurs throughout Peninsular India in all the drier areas, avoiding forest. *T. nudiventris* occurs in north and central Iran (Etemad, 1968), western Afghanistan around Jalalabad and Kabul and Kandahar (Gaisler, 1970) and extending coastwards to the Arabian peninsula, Israel, Egypt and the Sudan.



Distribution Map 14 Kutch Sheath-tailed Bat.

Being so plentiful in their roosts and having a predilection for man-made structures, these bats are often a nuisance in archaeological sites such as old tombs as they impregnate such buildings with a strong and unpleasant smell. In Thatta, colonies of this sheath-tail occupying ancient tombs are regularly raided by local people to render down their fat which is reputed to have medicinal properties and is sold in Karachi to 'hakims' (practitioners of country medicine).

**Biology:** Being such a widespread and plentiful species in Pakistan, this sheath-tail is better known in its habits. It is colonial in its diurnal roost and several smaller colonies frequently associate in separate but nearby roosts around a larger nucleus colony during the summer months. They normally adhere by the hind feet and thumbs to the open surface of a

vertical wall or rock face and do not conceal themselves in crevices like *T. perforatus*. Moreover they are not so shy when disturbed and will tolerate fairly close human approach in contrast to *T. perforatus* which invariably flies away.

They are extremely agile in their roosts and will scuttle sideways into darker shadows when approached but they are also tolerant of quite bright light if undisturbed. The largest colony observed by me was certainly over 2000 individuals and included both sexes.

In Pakistan they have local seasonal migrations and probably shelter during the winter months inside natural caverns, underground tunnels and crevices in buildings during which period they are in a state of torpor. The same summer roosts are regularly re-occupied and the whole colony appears to arrive within a period of two or three days. One such colony in Sadikabad exists in deserted ginning factory out-buildings. A colony in Sind has been found in an old mausoleum and another in a deserted railway station building. The Sadikabad colony, comprising about 800 individuals, arrives annually in the first week of March and each female produces a single young in mid April, there being a marked periodicity of the breeding cycle. The newly-born young appear greyish-black in colour, blind and naked and remain firmly attached to the mother's pectoral teats. They are carried by their mother even when foraging at night until they are about eight weeks old. Apparently at about this age the young learn to fly for themselves and become completely independent of their mothers. It has been also observed from the Sadikabad colony that when the young grow larger, at about the third or fourth week after birth, they are more usually carried clinging to the mother's flank and even occasionally clinging to her back. In September, when nearly five months old, the young though independent were noted to be clearly separable from the adults by their darker grey colouration and slightly smaller size.

Sexual activity and actual copulation has been observed in September in this region of southern Bahawalpur, though at Sanchi in central India, Brosset (1962, Part I) thought that the rut occurred in late March with parturition taking place in the first half of July. There may well be delayed implantation of the ovum in this species inhabiting the colder northwestern part of the subcontinent.

Fat accumulation occurs towards the end of the monsoon season and is visible as a yellowish-orange sub-cutaneous sheen in the region around the base of the lower back and base of the tail. In about the third week of October, colonies in both the Punjab and Bahawalpur region leave their summer roosts. Some may migrate to warmer latitudes but in Sadikabad whilst dismantling an old brick wall in December one year, a number of *T. kachhensis* were discovered hiding in the crevices, in a semi-torpid but quite wakeful condition. Their eyes were open and they were feebly active but they made no attempt to fly. A. Brosset believed that this species underwent prolonged periods of inactivity in central India during which, fat re-absorption took place. I have however encountered active colonies in Thatta District of Sind in early January, roosting on an open wall surface. In southern Sind the mild winters provide congenial conditions for abundant insect life which is certainly not the case in the colder northern regions of the Indus plain.

Like *T. perforatus* they are strong swift flyers and generally become very noisy and active in their roost about half an hour before sunset, but not emerging until about fifteen minutes after sunset at which time the majority fly off purposefully all in the same general direction. Based upon observations in Khanewal, it is believed that their hunting territory is extensive and that they normally hunt at a considerable height and

over a fairly straight and constant trajectory. They probably feed on all kinds of small insects, both dipterous and microlepidopterous.

In a colony of these Sheath-tails in Rahim Yar Khan it was observed that hawks used to frequent the area just at dusk and often succeeded in catching some of these bats as they emerged to hunt at night. The species of hawk was not identifiable (Mian Sharif, pers. comm.).

#### FAMILY MEGADERMATIDAE — FALSE VAMPIRES

Bats of this family are generally referred to as False Vampires though they are not blood-sucking species nor are they in any way related to the true Vampires of the Family *Desmodontidae* which are confined to South America.

There are three genera, embracing five species, of which one occurs in Africa, one in Western Australia and the remainder in South East Asia. All are characterized by being rather large bats with no tail or indeed caudal vertebrae, but an extensively developed interfemoral membrane. Also their large rounded ears are joined by a fold of skin across the crown and they have an elongated bifurcated tragus.

**Genus MEGADERMA** Geoffroy, 1810

**SUBGENUS *Lyroderma*** Peters, 1872

#### Key to the Pakistan Species of MEGADERMA

Large size. Forearm 65 to 72mm. Dorsal fur blue grey.  
... *Megaderma lyra*



Fig. 17 Showing front view of head of *Megaderma lyra*. Note bi-lobed tragus and noseleaf extending up between eyes.

#### MEGADERMA LYRA

*Megaderma lyra* Geoffroy, 1810; Indian False Vampire (see Illustration 10).

**Description:** This is a large bat with a rather ugly appearance due to its big head with prominent muzzle, huge naked ears and peculiar noseleaf (see Fig. 17).

The body fur is noticeably greyer than other bats inhabit-



Illustration 10 *Megaderma lyra*: Indian False Vampire.  
(Based on study specimens from the Punjab University collection from Lahore.)



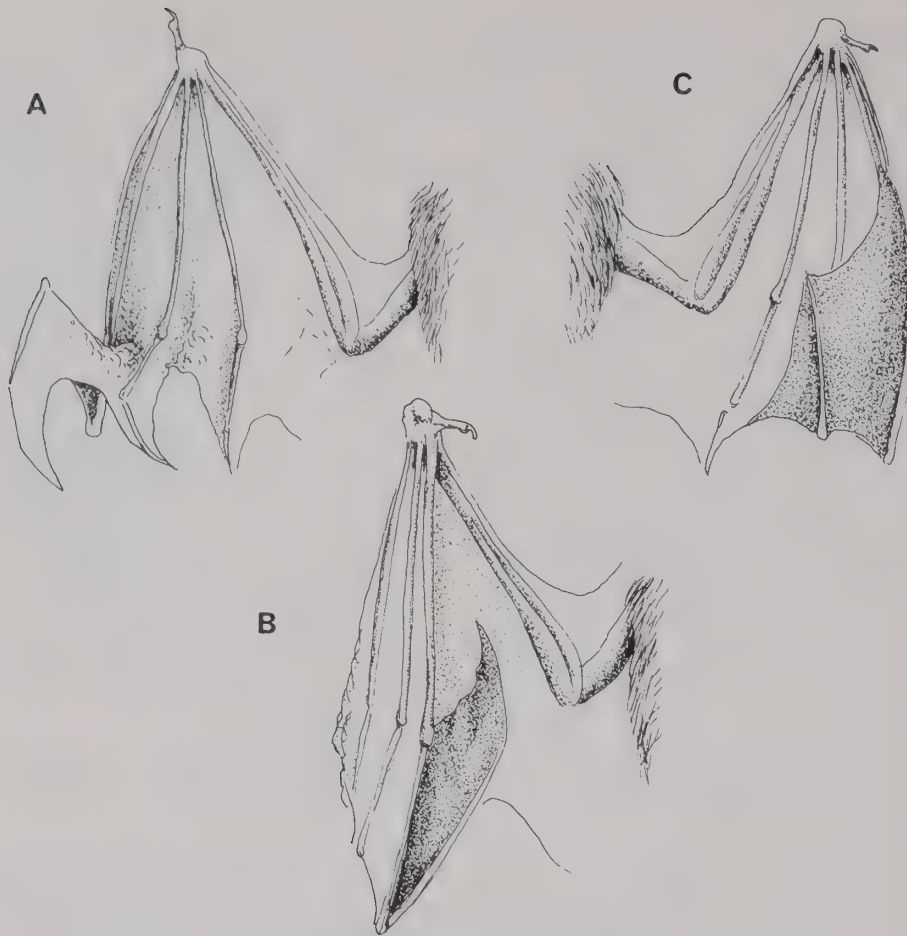


Fig. 18 Showing methods of folding wingtips when at rest, which are characteristic of certain bat genera.

- A. *Taphozous*. Ventral view right wing.  
 B. *Megaderma*. Ventral view right wing.  
 C. *Miniopterus*. Ventral view left wing.

ing Pakistan, being quite blue-grey dorsally and consisting of long silky hair. The belly fur is a paler, more yellowish grey. The wings are rather broad due to the last or fifth digit being relatively long (see Fig. 18). Such a design probably results in a slower but more controlled type of flight which is adapted to their method of hunting, described below. There is no trace of a tail in this species, but the interfemoral membrane is well developed, stretching from heel to heel and being supported by long but weakly developed calcars. There are two conspicuous dark vein-like lines stretching diagonally from the base of where the tail would normally be, to the heels (see Fig. 13). Their function is not known. The hind feet are comparatively large in this species and a further peculiar feature is in the development of the first digit which consists of only two joints (phalanges) whilst the remaining digits have three joints.

The head is dominated by the upright semi-naked ears which are bluntly rounded at their tips, sparsely covered with hairs and a pinkish-grey colour when the animal is alive. They are joined across the forecrown in a curve of folded skin. There is a conspicuous fringe of hairs on the inner margin of the ears and the tragus is long and slender, being divided into two lanceolate but unequal lobes. It is also pinkish-brown in colour and the outer lobe is much longer, up to 13mm ( $\frac{1}{2}$  in.), and more slender than the inner lobe which is blunter at its tip. The eye is quite large and conspicuous and the elongated noseleaf extends up between the eyes. The skin of the nose-

leaf is pink and naked and roughly lozenge shaped with a narrow vertical ridge running down its centre. This ridge widens in its anterior or lower portion to a small rounded disc in which the nostrils are recessed and under this again there is a wider foliaceous disc. The upper lips tend to be rather sparsely haired with a fleshy furrow dividing the middle of the lower lip. There are no incisors in the upper jaw.

Females have two pectoral mammae with two more false teats in the public region. These false dugs become very conspicuous in old females. Average dimensions of five specimens from Pakistan were: head and body length 87mm (76–94mm range); hind foot average 46mm (range 45–47mm); ear 37mm (33–40mm range) and forearm 70mm average (range 65–72mm).

**Distribution and Status:** In Pakistan this species seems to prefer fairly well-wooded regions with above average rainfall, avoiding the more barren regions of the Indus basin. It thus shows the typical distribution of an oriental faunal zone species, invading westwards adjacent to the Arabian coast as well as the Himalayan mountain chain.

In its diurnal roost it seems to prefer rather dark and sheltered places, though it will readily utilize man-made structures. In India, colonies have been observed in temples, cellars, natural caves and open walls, all these being man-made structures (Brosset, Part II, 1962). It is much more sensitive to



Distribution Map 15 Indian False Vampire.

daytime disturbance in its roost than to relative humidity and will tolerate quite dry locations.

This bat has been collected in the Murree foothills at Lehtrar at 920m (3000ft) elevation, and there is an irregularly occurring colony in some old ruined Mughal cellars at Shalimar gardens in Lahore. It has also been recorded from Sialkot.

At Sukkur in Sind, it has been found occupying hillside caves (these are shallow man-made caves in limestone conglomerate). It has also been observed entering the verandah of an occupied house in Karachi to devour its prey (Eates, 1968). The British Museum has one specimen, marked Baluchistan, and it seems likely that this specimen comes from Las Belas. It has not definitely been recorded anywhere else in Pakistan.

Elsewhere it occurs throughout India except in the Himalayas, Burma and Malaysia, but it is less common in more humid areas than *M. spasma*, its congener. It has not been recorded anywhere in Iran and has only recently been recorded in eastern Afghanistan in Nangahar Province (Gaisler, 1970) where it must be considered rare. In Pakistan it appears that this bat is rather rare and decidedly local in distribution, except in the northern sub-montane zone where it may be more widespread than is presently known. Further collecting will undoubtedly reveal its presence in the vale of Peshawar and possibly Mardan.

**Biology:** It is not highly gregarious in its diurnal biotope, usually not more than 15 to 20 individuals being found in the same roost. Both sexes seem to share the same shelter over most of the year though Brosset reports finding separate female colonies at the time of parturition (Brosset, Part II, 1962). I have observed that it is invariably very alert and shy when encountered in such roosts, flying away before allowing close approach. It also seems to prefer quite dark locations and avoids bright light. Possibly because of its predacious and carnivorous feeding habits it is rarely found sharing such places with other bat species. They always hang freely from the ceiling by their hind feet in such roosts.

The Indian False Vampire is quite a celebrated species

because it has been observed catching and devouring a variety of comparatively large vertebrate prey. In this respect it is unique amongst all the bat species inhabiting the subcontinent.

In hunting it only emerges when it is fully dark half an hour or longer after sunset and characteristically, it hunts very low down, searching the ground, the margins of pools and tanks or cliff and wall surfaces. Its comparatively broad short wings restrict its ability to fly very swiftly but enable it almost to hover over tree and rock surfaces while searching for prey. Its hunting territory is thus different from most Vespertilionid bats and even that of the Rhinolophidae (Brosset, Part IV, 1963). Moreover, its well-developed eyes, indicate that vision may also play an important role in detecting food prey. A specimen was encountered near Bombay which had accidentally become entangled in the thorns of a low *Zizyphus* bush 2ft above ground level (Goatly, 1963). It has a very characteristic habit of carrying its prey, once secured, to favoured perching sites where the meal can be devoured at leisure. These sites are usually open archways or overhangs apart from their roosting haunts and may be marked by the littering of the ground underneath with inedible or discarded elytra of *Coleoptera*, wings of *Acrididae*, feathers and wings of birds and other bones of reptiles and amphibians.

As early as 1844, Edward Blyth described watching this species catch a small *Pipistrelle* bat, which it devoured after sucking its blood (Blyth, 1844). An interesting account is given of this bat devouring a Wall Gecko (*Hemidactylus flaviviridis*) whilst hanging in the stair-well of an occupied lighted house. It commenced the meal by crushing the lizard's head and took about one hour and ten minutes to devour the whole, during which time several attempts to rob the prey by another *Megaderma* were vigorously resisted (Mosse, 1931). The major portion of this bat's diet is probably insects, as the wings of *Acrididae* and several species of moths have been found below their feeding places (Brosset, Part II, 1962). In Rajasthan it has been observed eating the harmless but rather formidable looking insect *Schizodactylus montrosus*, as well as quite large bats *Rhinopoma microphyllum* and *Taphozous perforatus* (Prakash, 1959B). It has been observed to be able to capture smaller bats such as *Pipistrelles* on the wing (McCann, 1934B) but the larger swift flying Sheath-tail must presumably have been overpowered whilst resting. In Lahore the remains of a House Sparrow (*Passer domesticus*) were discovered inside this bat's roosting place by Z. B. Mirza (pers. comm.). In detailed studies of the Indian False Vampire around Bombay, Crag Martins (*Hirundo concolor*), young House Rats (*Rattus rattus*) and frogs' legs were found to be regularly included in their diet (Brosset, 1962).

A detailed study of the breeding biology of the population in Uttar Pradesh and Maharashtra States in central India (Ramaswamy, 1962), reveals that breeding activity may extend over more than two months, and this may be the case even in Pakistan. The gestation period is apparently of rather long duration (150–160 days). In Afghanistan, close to the Pakistan border, a pregnant female was captured on 20 March, (Gaisler, 1970) and in the Lehtrar Valley a juvenile estimated to be about three months old was collected on 23 June. It was four-fifths of full adult size. In Aurangabad (central India) A. Brosset (1962) considered that sexual maturity was reached in about two years and that most young were born in mid April with marked periodicity in the breeding cycle. The young, though quick growing, apparently suckle for about three months (Ramaswamy, 1962). Z. B. Mirza (1970) stated that most young were born in November in Pakistan but does not give any evidence for this. In Rajasthan females of this bat were seen carrying young (attached to the false teats)



which had probably been born in late April or early May (Prakash, 1960A). The present existing evidence therefore points also to most young being born in March or April in Pakistan region.

*Megaderma* does not hibernate but probably makes seasonal or periodic short migrations. They appear to change their roosts frequently in Lahore region and do not occupy the same biotope for more than a few weeks continuously. They will also readily desert their roosts if molested.

There is no evidence that they have any natural enemies. They are too rare to be of any economic significance in Pakistan though their food habits would make them beneficial to agriculture.

## FAMILY RHINOLOPHIDAE – HORSESHOE BATS AND LEAF-NOSED BATS

### SUBFAMILY RHINOLOPHINAE

#### Genus RHINOLOPHUS Lacepède 1799

The family Rhinolophidae occurs throughout Africa, Europe and Asia, extending through the south west Pacific islands to Australia. The family is characterized by an elaborate noseleaf in which there is much variation so that over 150 different forms have been described. This noseleaf, however, conforms to a common plan.

All Rhinolophidae have relatively short rounded wings with the second digit comprising only one phalange whilst the third, fourth and fifth digits have only two joints. Their complicated noseleaf is thought to assist in their highly developed system of echo location.

The hind foot has three phalanges (joints) in each toe except the first which has only two joints. There is one pair only of very small incisors in the upper jaw.

#### Key to the Pakistan Species of RHINOLOPHUS

- (i) Large size. Forearm 57 to 60mm. Rear portion of sella bluntly rounded. Dorsal fur greyish brown, long and woolly.  
     ... *Rhinolophus ferrumequinum proximus*  
     Size slightly smaller (forearm 55–56mm) and dorsal fur with pale isabelline brown tips.  
     ... *Rhinolophus ferrumequinum irani*
- (ii) Small size. Forearm 34 to 40mm. Rear portion of sella bluntly rounded. Dorsal fur pale brownish white.  
     ... *Rhinolophus hipposideros*
- (iii) Medium size. Forearm 45 to 47mm. Dorsal fur pale brownish grey. Rear portion of sella prominent and sharply pointed.  
     ... *Rhinolophus blasii*

#### RHINOLOPHUS FERRUMEQUINUM

*Rhinolophus ferrumequinum* ♂ Schreber, 1774 – Greater Horseshoe Bat.

Subspecies *R. f. proximus* Anderson, 1905.  
 and *R. f. irani* Cheesman, 1921.

**Description:** It is desirable to describe the noseleaf appendages in some detail, as the separation of the many described species depends upon shape and structure differences.

The following description applies to all the Asian species of *Rhinolophus*.

At its lower or anterior portion, the noseleaf consists of a thin flattened disc of naked pinkish-brown skin just above the upper lip. When viewed from in front this disc is roughly circular or horseshoe shaped with its lower margin deeply notched medially, and nostrils lying recessed in the middle. At its upper or posterior end and between the eyes, the noseleaf narrows to a thin pointed appendage which is referred to as the 'lancet'. Generally it bears several long bristles on its proximal part as well as shorter hairs in the distal part and it curves forward slightly. The base of the lancet itself consists of complicated folds which form tiny receptacles or cup-like depressions in the side of the noseleaf. These may number two or three according to the species. Finally there is a third appendage lying in the middle of the noseleaf and separating the horseshoe from the lancet. This consists of an upright thickened structure which generally bears two curved peaks or points at its front and hind margins. This middle upright appendage is called the 'sella' from the Latin meaning a seat or saddle. The shape of the sella when viewed from the side is the easiest method of distinguishing the different *Rhinolophus* species likely to be encountered in Pakistan. The reader is advised to look at Fig. 20 together with the above descriptive account.

As its name implies, the Greater Horseshoe Bat is one of the larger species and is almost twice the size of the other two *Rhinolophus* so far recorded in Pakistan. Out of six specimens of *R. ferrumequinum* from Baluchistan, Dir and Swat the average forearm length was 57mm (2¼in.), head and body length 71mm (2.77in.) (range 57–80mm), tail 34mm (1.33in.) (range 30–39mm) (1.2–1.55in.), hind foot averaging 12mm (½in.) (range 11–15mm), and ear 24mm (0.9in.) (range 22–26mm). The population inhabiting the northern Himalayan region appears to average larger than the Baluchistan population with the forearm averaging 58mm (2½in.) whilst *R. f. irani* has the forearm averaging 56mm (2.2in.).

The Greater Horseshoe Bat has long almost woolly body fur and this thick fur gives the head a rather rounded or domed appearance when viewed laterally or dorsally. The fur is greyish-brown with paler bases to the hairs on the back and the ventrum is creamy brown colour.

The interfemoral membrane is well developed and supported by strong calcars without any lobe of skin beneath them. The last vertebrae of the tail just extends beyond the interfemoral membrane and the tail itself is comparatively short in comparison to that of typical Vespertilionid Bats (see Fig. 19). There are two conspicuous vein-like lines (believed to be muscle fibre) radiating from the base of the tail on each side of the interfemoral membrane and these lines bifurcate with one branch descending to the calcaneum. The wings have very delicate almost translucent membranes and are rather short and rounded in outline. The comparatively broad ears have no tragus but the outer margin curves round to form a prominent anti-tragus (see Fig. 20) and the inner surface of the conch is marked by eight or nine transverse ridges. The ear itself is pale brown, semi translucent, and terminates in a sharp point with a broad fold along its inner convex margin and the other margin always being concave. In this species the noseleaf is characterized by the lancet being quite large and conspicuous (about 11mm (0.45in.) long) and having three cup-like receptacles in its side. The sella is bluntly rounded at both upper corners when viewed laterally (see Fig. 20). The nostrils lie in a deep groove of the horseshoe which is also notched on its lower margin and covers the upper lip when viewed from in front. The muzzle of this bat is well covered with hairs.

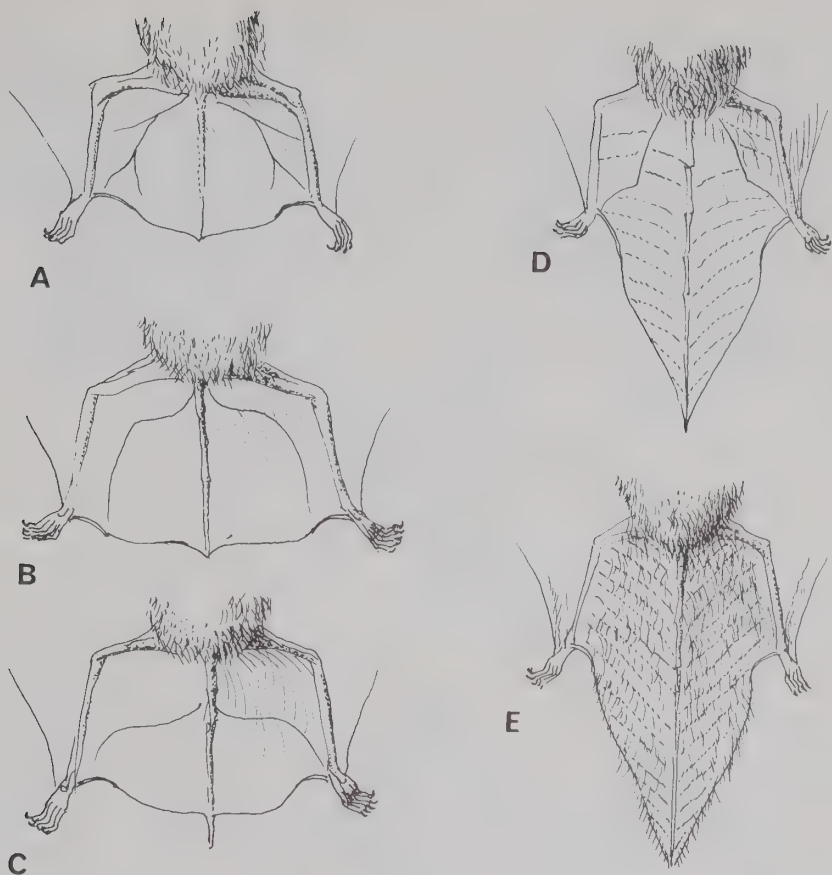


Fig. 19 Showing dorsal view interfemoral membrane of certain Microchiropteran genera.  
A. *Rhinolophus ferrumequinum*. Note tail relatively short compared with length of hind leg.  
B. *Hipposideros fulvus*.  
C. *Asellia tridens*. Note tip of tail extending beyond interfemoral membrane.

D. *Barbastella leucomelas*. Note tail is considerably longer than hind leg but wholly enclosed by interfemoral membrane.  
E. *Murina buttoni*. Note dorsal surface of interfemoral membrane sparsely covered with hairs. In these five genera represented, there is no lobe below the calcar.

The eyes are extremely minute. All the Horseshoe bats have only one pair of very small upper incisors. Adult specimens from Europe weigh up to 25g ( $\frac{7}{8}$  oz).

**Distribution and Status:** This Horseshoe Bat seems to be widely distributed throughout the northern Himalayan valleys and probably extends southwards through the mountains of Waziristan and northern Baluchistan, though it has not yet been collected from these regions. In southern Baluchistan this bat seems to be rare probably because of the very dry climate which is unfavourable to the Rhinolophidae as well as the presumed lesser supply of suitable insect prey. Specimens have been collected from around Dir town (Dir State), Kululai in Swat Kohistan and Gilgit. These larger greyer specimens have been assigned to the subspecies *R. ferrumequinum proximus*. In Baluchistan it has so far only been collected from Kalat and Nushki, and specimens have been assigned to *R. ferrumequinum irani* (Mirza, 1965). It was only found in small colonies of eight to ten and roosting in underground irrigation channels in Kalat (Z. B. Mirza, pers. comm.). It has not been found in its diurnal roost in the northern regions, but it is known from studies in other regions that this species prefers very sheltered dark roosting places having high humidity. Natural rock caverns would probably provide such conditions in the Himalayas. In the light of present knowledge it is



Distribution Map 16 Greater Horseshoe Bat.



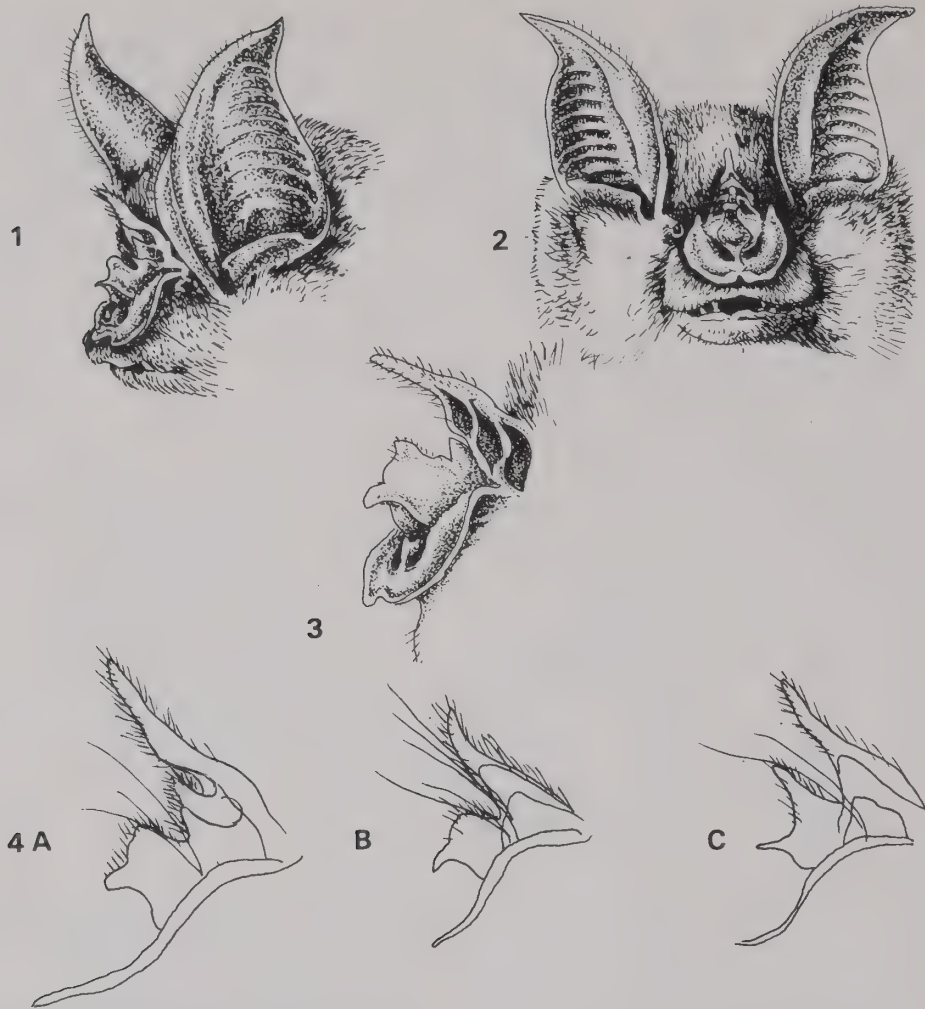


Fig. 20 Showing characteristic features of Horseshoe bats.

1. Side view of head showing low broad antitragus with absence of any tragus.
2. Front view showing typical appearance of horseshoe noseleaf.
3. Detail of noseleaf of *Rhinolophus ferrumequinum* viewed laterally. Note three leaf-shaped receptacles or depressions at base of lancet with nostrils recessed in thin platelike disc below sella.

4. Diagrammatic lateral view of noseleaf of three *Rhinolophus* species.

- A. *Rhinolophus ferrumequinum*.
- B. *Rhinolophus hipposideros*.
- C. *Rhinolophus blasii*.

Note posterior portion of sella bluntly rounded for Greater and Lesser Horseshoe Bats but terminating in pronounced point for Peters' Horseshoe Bat.

believed to be less common than other bat species inhabiting the same regions of Pakistan and it seems rather rare in Baluchistan.

Outside of Pakistan, it occurs in the north western Himalayan regions of India, north and central Afghanistan where most of the population corresponds to the subspecies *R. f. irani* (Gaisler, 1970) and in all of Iran except the south eastern part (Etemad, 1969). It occurs widely throughout Europe, southern Russia and the Mediterranean basin including Israel, Algeria and Morocco. It also spreads to Japan and Korea.

**Biology:** This species has been well studied in western Europe (Coward, 1908, Mohres 1953, Southern, 1964). They are gregarious, roosting in clusters in their diurnal roost. They adopt a very characteristic attitude, hanging freely by their hind legs with the head tucked in to the breast and enveloped by the folded wings which are wrapped right around the body (see Illustration 11). The tail is also always folded over back-

wards and the interfemoral membrane partly covers the lower back. As mentioned above their wing membranes are very thin and fragile and it is probably partly to protect these from desiccation that this bat prefers humid places for its roost (Brosset, Part II, 1962).

When not sleeping, the head is carried at right angles to the axis of the body and if disturbed they can be observed to tremble their ears and rotate their heads as though trying to pick up sound waves and detect the source of disturbance. Horseshoe Bats do not cling to vertical surfaces as do the *Pipistrellus* species and they need some overhead horizontal support for alighting. High speed photography has recently revealed that *Rhinolophus* bats have a unique way of alighting, making a forward somersault and closing their wings and grasping the support with their toes as their body comes over. Vespertilionid bats, invariably land on a vertical surface.

In their roost they are gregarious and both sexes hang together, often in close-packed clusters. At the time of parturition the females form separate colonies. They generally

change their roost to a more sheltered location before the onset of winter and this species always undergoes hibernation. Specimens from Nushki were quite active when collected on 31 October, (Mirza, 1965), but specimens from eastern Iran were found hibernating by mid November (Lay, 1967). In hunting habits they are quite different from most other Microchiroptera. They have an erratic fluttering flight which is comparatively slow and their hunting territory is restricted in area. They can be seen each night around the periphery of certain trees, buildings or even low bushes and they search these tree or bush surfaces rather than open air spaces. They are solitary in hunting, each individual keeping to separate hunting territories. They can hover to pick insects off twigs and leaves and normally settle on some surface to consume larger prey. Considering their size, their teeth are weak and small and they hunt mainly smaller insects such as mosquitos, lacewings and micro-lepidoptera. They will also pick small spiders off foliage and if they capture a grasshopper (*Tettigonia* spp.) this is eaten after clipping off and discarding the wings. Their interfemoral membrane is not wide enough to be utilized as a pouch for holding insects while in flight as is the case with most Vespertilionid Bats.

The Greater Horseshoe Bat normally never emerges to hunt before darkness and is a strictly nocturnal species. Like others of the genus *Rhinolophus* it has been found to hunt with its mouth closed, emitting ultra-sonic noises through its nose (Mohres, 1953). Thus, the foliaceous appendages of the nose-leaf probably help to shield out direct noises from the ears, and the lobes and structures around the nostrils are thought to function in channelling and focusing sound impulses echoing back from an object so that they achieve maximum intensity some 6m (19½ft) in front of the bat (Mohres, 1953).

There is delayed implantation of the ovum with the rut taking place in October or November and the ovum being implanted in the spring. The gestation period is about nine weeks with a marked periodicity in the breeding cycle and it is probable that like the European population of this species, the females all produce their young within a few days of each other in the late spring or early summer. A single young is born which is sparsely covered with hairs. For a considerable time the young is carried, attached either to the mother's teats which are located close to the armpits or in an inverse position attached to one of the two pubic false teats. Growth is believed to be quite rapid in the first three weeks but after one year, juveniles are still separable from adults by size and colouration (Brosset, Part II op. cit.).

Females are believed to be sexually mature at two years and there are records of ringed specimens having lived 18 years (E. Walker, et al., 1964).

### RHINOLOPHUS HIPPOSIDEROS

*Rhinolophus hipposideros* Bechstein, 1800; Lesser Horseshoe Bat.

**Description:** Very similar to the Greater Horseshoe Bat in external form but much smaller and having a more delicate build. The body fur is comparatively long and dense, as in the Greater Horseshoe, but it has more of an isabelline brown tone dorsally. The noseleaf is also a miniature replica of the Greater Horseshoe Bat with the sella in profile having bluntly rounded posterior and anterior points (see Fig. 20). The wings are short and broad with the skin very thin and translucent. The tail is wholly enclosed in the interfemoral membrane.

I have not been able to measure any specimens from Pakistan. Typical specimens from Afghanistan and Iran have the

forearm varying from 39–41mm (1.5–1.6in.) with a body length averaging 39mm (1½in.), tail 40mm (1.59in.), hind foot 7mm (¼in.) and ear 16.5mm (0.63in.).

**Distribution and Status:** A specimen was collected by Anderson in 1918 from Gilgit according to Ellerman and Morrison-Scott (1951). There are no specimens at present in the collections of the British Museum or Bombay Natural History Society from Pakistan but there is no reason to doubt Anderson's record. Practically no collecting has been done in the Gilgit region in the past fifty years except that by the University of Maryland Expedition in 1965 and they did not encounter any *Rhinolophus* species. However, the Lesser Horseshoe has been collected in northern Iran (Etemad, 1969) as well as in western Afghanistan in several localities close to the Pakistan border with the Malakand Agency and Zhob district in Baluchistan (Gaisler, 1970). It is also widespread in Russian Turkestan and Tadzhikistan (Flint et al., 1965 and Bobrinskii et al., 1965).

It is known to be a less common species generally than the Greater Horseshoe Bat, wherever the two occur, and is probably less gregarious in its diurnal roosts.

**Biology:** Much the same as for the Greater Horseshoe Bat but it is not so gregarious in its diurnal roost though it hangs in exactly the same way by its hind feet, choosing some darkened and very sheltered natural cave or man-made tunnel or cellar. Furthermore they do not hang in clusters and the individuals are always dispersed.

They have the same fluttering flight but with quicker wing beats, and also the ability to hover in a stationary manner and their hunting territory is close to the surface of bushes or trees.

They are known to enter full hibernation in winter.

The gestation period is shorter than that of *R. ferrum-equinum*, being about seven weeks, and sometimes two young are born at a time.

### RHINOLOPHUS BLASII

*Rhinolophus blasii* Peters, 1866; Blasius' Horseshoe Bat or Peters' Horseshoe Bat (see Illustration 11).

**Description:** This is also a small Horseshoe Bat but it generally averages slightly larger in body size than the Lesser Horseshoe. Average forearm length of specimens from Arabia being 45.5mm (1.77in.) with the head and body length averaging 43mm (1.7in.) and tail 26mm (1in.). The single known specimen from Pakistan had the forearm 41mm (1.65in.) long, head and body 33mm (1.28in.) and tail 21mm (0.82in.). The ear was 15mm (0.58in.) long.

The body fur is typically very long and dense with the dorsal hairs being whitish-brown at their base and the tips, a dark grey-brown.

The main distinguishing feature of this species, is the shape of the sella in which the rear (or upper) part rises to quite a prominent slender point (see Fig. 20). No other Horseshoe Bat in the region has a sella so shaped. The lancet also tends to be slightly blunter at the tip. According to D. L. Harrison (1964) adult specimens from the Mediterranean region weigh from 15–18g (½–⅝oz).

**Distribution and Status:** It is only known from one specimen (in spirit, now lodged in the Punjab University Zoological Museum) which was collected alive on 28 December 1968 by Z. B. Mirza and the author, from some old cellars at



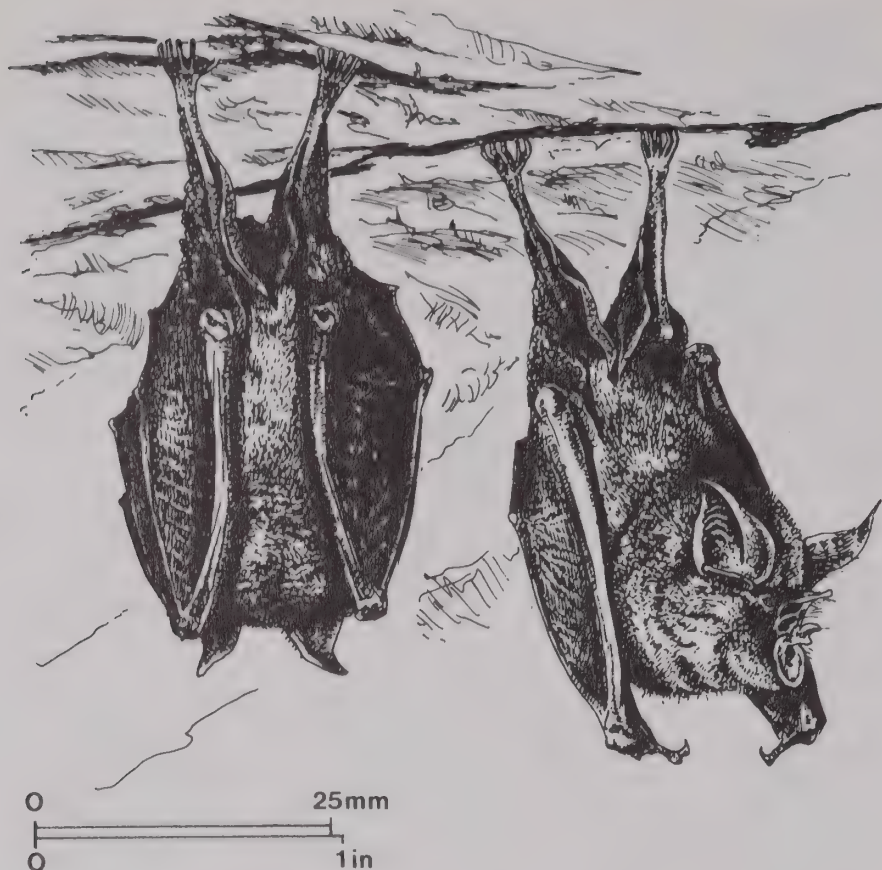


Illustration 11 *Rhinolophus blasii*: Peters' or Blasius' Horseshoe Bat. (Based on live specimen collected from Lahore.)

Shalimar Gardens in Lahore. It allowed approach and capture, being in a semi-torpid state.

In Iran large colonies of this species have been observed as it is normally quite gregarious in its diurnal biotope. It is noteworthy that an early record for this species by Anderson for south eastern Iran is quite possibly within what is now Pakistan territory (Lay, 1967 and Anderson, 1905) in the Mekran. It also occurs in Russian Turkestan, in regions adjacent to Pakistan (V. I. Flint, et al., 1965).

**Biology:** Little has been recorded specifically but it is known to hibernate in winter, the females form separate maternal colonies and, as in other *Rhinolophidae*, parturition in the whole colony occurs within a few days.

#### SUBFAMILY HIPPOSIDERINAE — LEAF-NOSED BATS

The Hipposiderinae are obviously closely related phylogenetically to the *Rhinolophidae* family. Like the former they are relatively small bats with elaborate noseleaf appendages, large widely spaced ears, relatively broad wings and a rather slow and fluttering type of hunting flight.

They differ from the Horseshoe Bats in several minor anatomical respects. Six genera and about 130 species are recognized and they are confined to the warmer or tropical regions of the old world. They are not found in the Palearctic region or either American continent.

In contrast to the *Rhinolophidae* they have one less pre-

molar in the lower jaw and a slightly different structure of the shoulder and hip girdle. In all *Hipposideros* species the digits of the hind feet have two joints, whereas in *Rhinolophus* except for the first digit, the remaining toes have three joints. Finally the noseleaf is very distinctive. Somewhat square in outline when viewed from in front, its posterior or upper portion never terminates in a pointed lancet as in the Horseshoe Bats but usually takes the shape of a thin flattened disc. The ear has no tragus but the anti-tragus is well developed and is more lobed in outline and less flattened than the anti-tragus of Horseshoe Bats (see Fig. 21).

#### Genus HIPPOSIDEROS Gray, 1831

This genus contains about 25 species inhabiting Africa, Madagascar and most of South East Asia to the northern tropical regions of Australia. Ecologically, they are quite distinct from the Horseshoe Bats, being tropical species which never undergo true hibernation.

#### Key to the Pakistan Species of HIPPOSIDEROS

- (i) Forearm 40 to 45mm. Anterior surface of rear or upper portion of noseleaf indented into three shallow troughs or pits (see Fig. 22C/2). Dorsal fur whitish brown basally and tipped dark chestnut brown.  
... *Hipposideros fulvus*
- (ii) Forearm 33 to 37mm. Anterior surface of rear or upper portion of noseleaf not indented into shallow troughs. Dorsal fur tipped greyish brown.  
... *Hipposideros cineraceus*

## HIPPOSIDEROS FULVUS

*Hipposideros fulvus* Gray, 1838.

Synonym *Hipposideros bicolor* Temminck, 1834;

Bicoloured Leaf-nosed Bat, also called Bi-colour Roundleaf Horseshoe Bat.

**Taxonomy:** Originally assigned to a separate species *H. fulvus*, this form was treated by Ellerman and Morrison-Scott (1951) as no more than a subspecies of *H. bicolor*. In a recent revision of the Genus *Hipposideros*, this population from the dry north west has again been treated as a distinct species *H. fulvus* (J. E. Hill, 1963A). It is closely similar in appearance to *H. cineraceus* from which it can only be distinguished by its slightly greater size, and in the Pakistan population by the paler bases or roots of its dorsal pelage. In the checklist published by the Zoological Survey of Pakistan, *H. cineraceus* is included as occurring in West Pakistan as also in Siddiqi's account of British Museum material (Siddiqi, 1961 and 1970). A single specimen was collected in 1853 in the Salt Range near Pind Dadan Khan (Blyth, 1853). This is no longer traceable and the good series of specimens of *Hipposideros* in the British Museum and Bombay Natural History Society collections collected from the same Salt Range locality all belong to *H. bicolor* (*fulvus*). Since the main distribution of *H. cineraceus* is typically associated with forested regions of higher rainfall in the eastern parts of northern India, Burma and Malaya, this specimen of Blyth's was probably a sub-adult *H. fulvus* or a case of mistaken identification at a time when the known distributional range and indeed the taxonomy of this Genus was not well worked out.

**Description:** The dorsal fur of this species can vary widely in colour in parts of western India (Brosset, Part II, 1962) but in Pakistan all specimens from the Punjab have long

soft fur with the hairs pinkish-white basally, terminating in dark reddish-brown or chestnut tips, hence the scientific name *bicolor*. Some individuals have more yellowish-white fur close to the body with the tips of the hairs grey-brown or even golden-yellow in specimens from Sind according to J. A. Murray (1874). Their ventral fur is paler yellowish-white, varying to almost pure white and in the field the rather streaked appearance of the body fur is reminiscent of the down of young birds.

It is a small bat with the tail wholly enclosed by the inter-femoral membrane (see Fig. 19) and the wings rather short and broad and delicately constructed. The ears are large reaching 22mm (0.88in.), being somewhat longer than that of similar sized Horseshoe Bats. They bear nine or ten transverse ridges inside the conch. The outer margin curves round in a conspicuous rounded anti-tragus and the ear is rather rounded at the tip being not so sharp pointed as in *Rhinolophus* species, resulting in the outer margin of the ear being less concave in outline (see Fig. 21).

The noseleaf consists of a naked, brown skinned pad, roughly square in outline. The anterior portion next to the tips contains the nostrils which are divided by a raised septum which is triangular in outline — broad at the base, narrower between the nostrils. The lower margin of this noseleaf is only slightly indented and there are no subsidiary or accessory lateral leaflets as in *Asellia* and some of the other tropical *Hipposideros* species. The middle or central portion of the noseleaf, which is equivalent to the sella of the Horseshoe Bats, consists of no more than a rounded fleshy lump or pad (see Fig. 21). It is the anterior part of the noseleaf which is most strikingly different from the Horseshoe Bats. Viewed laterally it is a thin rounded leaf or projection arcuate in outline. From in front it is slightly concave with its anterior face divided into four shallow cells by the presence of three vertical ridges (see Fig. 21). *H. cineraceus* has a very similar

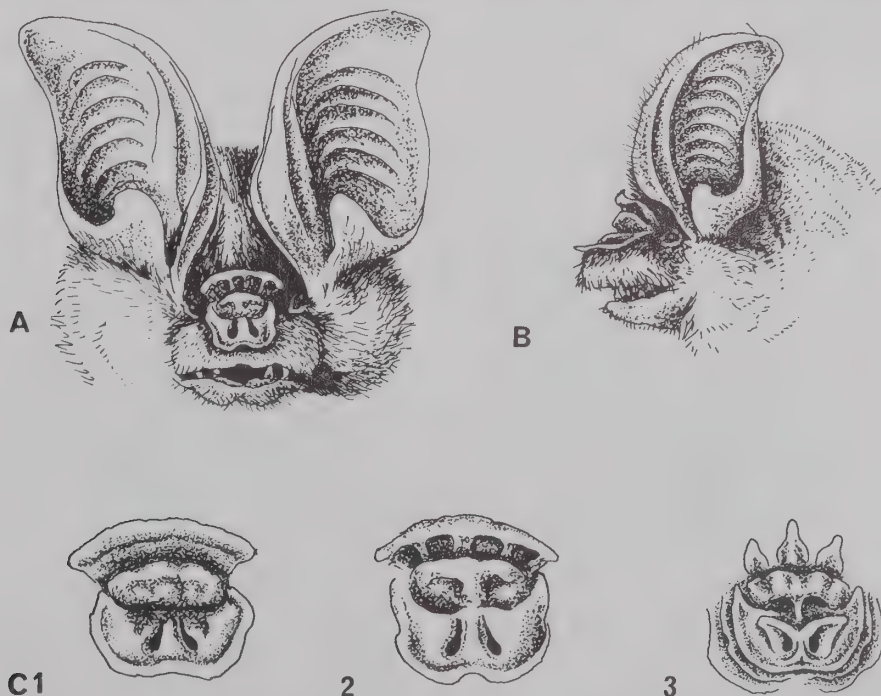


Fig. 21 Showing characteristic features of *Hipposideros* bats.  
A. Front view of head of *Hipposideros fulvus*.  
B. Lateral view of head of *H. fulvus*. Note antitragus slightly lobed and posterior part of noseleaf arcuate when viewed laterally.

C. Showing detail of noseleaf, viewed from front.  
1. *Hipposideros cineraceus*.  
2. *Hipposideros fulvus*.  
3. *Asellia tridens*.



noseleaf except that this posterior or upper leaf is not divided into four cells (see Fig. 21).

Out of 16 specimens from Pakistan the head and body length averages 44mm (1.72in.) (range 41–49mm) and the tail averages 27mm (1.05in.), (range 22–29mm). The hind foot averages 8mm (0.31in.) (range 5–9mm) and the ear averages 21mm (0.8in.), (range 20–23mm). The forearm varies from 38.8–43mm (1.5–1.7in.) with the average about 42.2mm (1.65in.) in the British Museum series. *H. cineraceus* has the forearm smaller, varying from 33–37mm (1.3–1.49in.) in length.

A specimen from Afghanistan weighed 9g (0.3oz) (Gaisler, op. cit.), and Malayan specimens vary from 8–10g (0.28–0.35oz) in body weight (Medway, 1969).

**Distribution and Status:** This species seems well adapted to arid regions in areas having a scattered growth of tropical thorn scrub or dry sub-tropical scrub. It seems to be quite eclectic in its choice of diurnal roost but normally prefers fairly dark sheltered localities and often favours subterranean cavities. It has been found at sea level and in quite high plateau areas (up to 310m (1000ft) elevation in the Salt Range). It is gregarious, roosting in colonies of from 5 to 10 individuals up to 200 in suitable caverns. It particularly favours the open burrows of Porcupines and Hyenas for its diurnal roost as well as utilizing underground cellars, railway tunnels, open wells and, in Baluchistan, 'kharezes'. The size of these cavities need not be large but locations are preferred where several alternative cavities are available, probably to give refuge if they are disturbed, as they are very susceptible to predation from crows and kites if flying abroad in daylight (Brosset, Part IV, 1963).

Specimens have been collected in the northern Punjab from around Rawalpindi and the Salt Range. It apparently does not penetrate into the foothills in the north, and is absent from most of the Indus plain, occurring again in southern Sind around Sukkur, Ghalam and Ghara. There used to be a considerable colony in the 1960s in the Mausoleum of Amir Khan

Mona at Thatta. In southern Baluchistan it has been collected from Panjgur and Hoshab. It thus has the typical distribution of an oriental faunal zone species occurring mainly in the coastal and sub-montane areas. It does not appear to be particularly numerous even in the regions where it occurs in Pakistan.

Elsewhere it is more widespread and common in western India as far north as Kutch but it has not been recorded in Rajasthan. There is a single record for Afghanistan close to Jalalabad (Gaisler, 1970) and it has not spread westwards into Iran. *H. bicolor*, if conspecific with *H. fulvus*, spreads throughout south east Asia to Thailand, Indonesia, Burma and Taiwan.

**Biology:** According to observations in India this gregarious bat frequents the same favoured diurnal roosts for many years on end (Brosset, 1962). Usually the colonies consist of no more than 10 to 20 individuals. Like the Horseshoe Bats, they hang upside-down, freely suspended by their hind feet. Both sexes seem to share the same roost throughout the year, unlike many of the Horseshoe Bats, but females were concentrated in the centre with males on the periphery in one colony near Bombay (Abdulali, 1948). They do not hang in clusters but each individual hangs separately and apart. As indicated above they seem to have a predilection for cavities below the ground surface and these may not be unconnected with the fact that their hunting territory remains close to the ground surface.

They have a slow but fluttering flight following the contours of the ground and bushes with frequent changes of direction. Colonies in India were noted emerging fifteen minutes before sunset, (Brosset, 1962). Like other *Hipposiderinae* they do not have separate territories but 4 or 5 individuals commonly hunt together over the same piece of ground. They have been observed frequently returning to their diurnal roost while hunting and may spend a large part of the night thus resting (Brosset, 1962). With their weak dentition they are believed to feed mainly upon smaller and soft insects such as mosquitos.

Parturition is quite periodic with young being born close together in April around Bombay (Brosset, 1962) as well as Malaysia (Medway, 1969). Nothing is recorded about the Pakistan population but it seems probable that parturition is also in April. A juvenile was collected at Rohtas in the Salt Range on 3 July which was still sub-adult size and was estimated to be not more than six weeks old. A. Brosset (1962) thought the rut occurred in January and that the gestation period is around ten weeks. The juveniles apparently suckle until nearly adult size and do not hunt independently until about six weeks old. They remain, while suckling, firmly attached to the mother's false teats for about 40 days (Brosset, 1962). In the Bombay colony, females were still carrying young in mid June (Abdulali, 1948). Studies of other *Hipposideros* Bats indicate that the young are invariably carried in the inverted position attached firmly to one of the female's false teats situated in the pubic region. At birth the young are blind and naked.

Females are believed to reach sexual maturity between 18 to 20 months of age. A wild specimen banded near Bombay was recaptured when at least 12 years old at which time it was pregnant with a well-developed embryo (Ali, 1953).

According to A. Brosset the Leaf-nosed Bats in India have no period of true hibernation in contrast to the Rhinolophidae. In Pakistan they probably undergo prolonged periods of inactivity and semi-torpority in the winter when there is certainly not much insect life in the northern Punjab or the southern part of Baluchistan, where they occur.



Distribution Map 17 Bi-coloured Leaf-nosed Bat or Bi-coloured Roundleaf Horseshoe Bat.

In Baluchistan *H. bicolor* (*fulvus*) has been found roosting in association with *Rhinolophus ferrumequinum* (Z. B. Mirza, pers. comm.) and in western India in association with *Rhinolophus rouxi* (Abdulali, 1948) but one authority considered it generally unsociable, preferring separate colonies (Brosset, 1962).

### Genus ASELLIA Gray, 1838

#### Key to the Pakistan Species of ASELLIA

Ears relatively large, averaging 19mm in length. A conspicuous, roughly square noseleaf having its rear or posterior portion terminating in three equidistant prominent fleshy points. Anterior portion of noseleaf surrounded by two secondary leaflets (see Fig. 21). Tips of tail extending well beyond interfemoral membrane. Dorsal fur pale blond or silvery buff. Forearm 44 to 53mm.

... *Asellia tridens*

This genus is closely similar to *Hipposideros* except in the shape of the noseleaf. Also several terminal caudal vertebrae extend beyond the interfemoral membrane.

### ASELLIA TRIDENS

*Asellia tridens* Geoffroy, 1813; Trident Leaf-nosed Bat.

**Description:** It can be distinguished from *Hipposideros bicolor* in its diurnal biotope, by its larger size, paler dorsal colouration, and habit of hanging by its thumbs. It has relatively long soft fur and the basal portion of the hairs are pale yellowish-white with the tips more isabelline-brown but not contrasting so darkly as in *H. bicolor*. There is some individual variation in body fur from bright golden-yellow to silvery-blond and the ventrum is a paler creamy-white. The ears are broad and upstanding, terminating in a point with both anterior and posterior margins convex towards the tip and the inner margin folded outwards and bearing a fringe of hairs along the fold. Compared with the Horseshoe Bats the ear is relatively larger and more conspicuous, but the average length in Pakistan specimens is 19mm (0.75in.), considerably

shorter than the ears of *H. fulvus* which are 22mm (0.87in.). There is no tragus and the outer margin curves round to form a less conspicuous lobe than in *H. fulvus* and it bears a conspicuous bluntly rounded projection on its outer margin. The anterior surface of this antitragus is thickly haired but the rest of the ear pinna is semi-translucent and naked, being greyish-brown coloured.

The noseleaf consists, like that of *Hipposideros*, of three parts. The anterior or lower disc of bare skin, has two secondary or irregular outer leaflets surrounding the central horseshoe (see Fig. 22), which covers most of the upper lip. There is no indentation on the lower margin of the central horseshoe. The two nostrils are divided by a parallel sided septum and their margins are raised like the mouth of a trumpet. Their shape may in fact, well function like that instrument in magnifying noise emitted through the nostrils, as this species, like the *Hipposideros* bats emits ultrasonic calls through the nose and hunts with its mouth closed until prey is located. The middle portion of the noseleaf (equivalent to the sella in the Rhinolophidae) consists of a low rounded fleshy pad which tends to have a slightly protuberant median rounded ridge. The rear or superior part of the noseleaf (equivalent to the lancet in the Horseshoe Bats) gives rise to its specific name. It consists of an erect leaf with four shallow cups or indentations in its anterior face divided by three ridges or septa. On top of this are three conspicuous projections with the central one tallest and more pointed. The two outer ones tending to curve outwards add to the trident, three pronged appearance.

The wings are comparatively short and broad, with delicate membranes. The interfemoral membrane is not very deep, being supported by rather weak calcars. The tail barely extends in length beyond the level of the feet and 3–5mm (0.12–0.2in.) of the tail tip extends free beyond the margin of the interfemoral membrane (see Fig. 19).

Fourteen specimens from Pakistan had the head and body length averaging 54mm in length (range 52–65mm) with the tail 25mm (range 22–28mm), the hind foot averaging 9mm (range 9–10mm) and the ear averaging 19mm (range 18–20mm).

**Distribution and Status:** This species is highly gregarious in its diurnal roost like the Horseshoe and Round Leaf-nosed

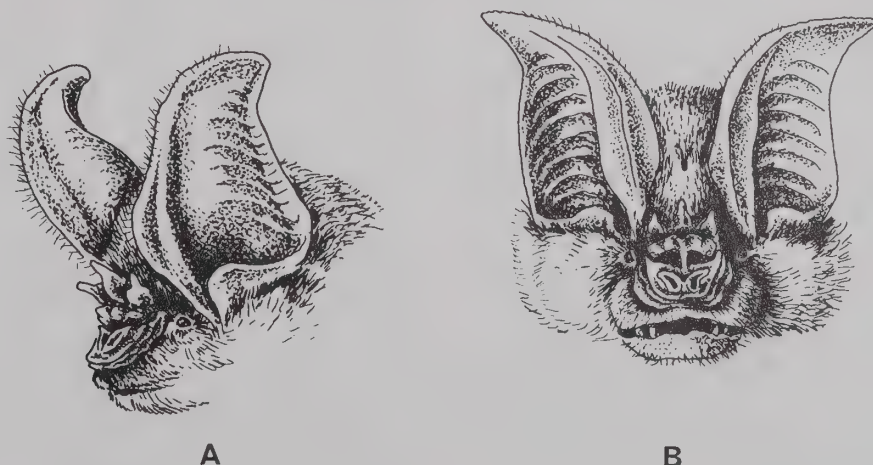


Fig. 22 Showing head of *Asellia tridens* with characteristic appearance of noseleaf.

A. Lateral view.

B. Front view.

Note secondary or outer leaflets below anterior portion of noseleaf.





Distribution Map 18 Trident Leaf-nosed Bat.

Bats, and seems to form larger colonies than *H. fulvus*. It utilizes underground irrigation tunnels (kharezes) in Baluchistan, natural caves, old tombs (in Thatta district) as well as open wells. It is characteristically associated with the arid-tropical regions of Sind and Baluchistan in the warmer more southern latitudes and appears to undergo local seasonal migrations.

In Pakistan it has been collected in the Mekran at Panjgur and also at Nushki in 'kharezes'. It also occupies caves on the sea coast around Karachi. It has been collected on the Mekran coast (Siddiqi, 1961) and also in old tombs at Thatta, particularly Nawab Isa Khan's tomb. It has not been recorded from anywhere north of these regions either in Sind or in Baluchistan, and this accords with its known distribution westwards where it occurs throughout the dryer warmer southern portion of Iran (Etemad, 1968) and through the Middle East to Egypt, Somaliland, Eritrea, Libya, Algeria and Morocco (Harrison, 1964). It has not been recorded in India. It has however, been recorded in Afghanistan, probably in Seistan region (Aellen, 1959).

In Pakistan it has been described by K. R. Eates as literally swarming in Karachi in the early part of the summer (Eates, 1968). However, my negative observations indicate that it is not particularly plentiful even in southern Sind, and Karachi appears to form the easternmost limit of this species' known world range.

**Biology:** Not much is recorded or known about the habits or ecology of the Trident Leaf-nosed Bat. According to numerous observations in Aden, Iran and Iraq (Harrison, 1964, and Lay, 1967), this species changes its roost at different seasons and probably undergoes local migrations to warmer latitudes in winter.

It is highly gregarious in its diurnal biotope and colonies comprising several hundred individuals have been recorded occupying the same cavern in Oman (Harrison, op. cit.). A small colony found near Panjgur by Colonel J. E. B. Hotson (Bombay Natural History Society, 1920) contained only females and may have been a maternal colony. Most of the

summer colonies appear to be vacated at the onset of colder weather in southern Iran (Lay, 1967) but whether the species goes into hibernation or migrates southwards to warmer coastal areas is not known.

In the roost they characteristically cling with both their hind feet and thumbs unlike the *Hipposideros* species and they are apparently not particularly shy as they are said to be a nuisance in summer, occupying houses in inhabited villages (Lay, 1967).

Their hunting manner is rather similar to *Hipposideros* in that they have a relatively fluttering flight and stay close to the ground surface or around bushes. D. L. Harrison observed that they emerged 'rather late in the dusk' (Harrison, op. cit.). Their flight is described as swift by several authors (Walker et al., 1964, and Harrison, 1964).

A single young appears to be born in the spring of the year, a colony of pregnant females having been encountered in Aden in April (Walker et al., op. cit.).

Detailed studies have shown that they have a highly developed echolocation system. They fly with the mouth closed like *Rhinolophidae* but the sounds emitted through the nose are intermediate between those of the true Horseshoe Bats and the *Vespertilionids*, including short bursts of low frequency calls similar to those used by *Vespertilionid* bats (Mohres and Kulzer, 1955).

## FAMILY MOLOSSIDAE – FREE-TAILED BATS AND TOMB BATS

### Key to the Family Molossidae in Pakistan

Medium- to large-sized bats with distal portion of tail entirely free and emerging from the bottom of the outer edge of the interfemoral membrane. Tail rather fleshy and interfemoral membrane rather short (see Fig. 23). Lips bear vertical folds giving the mouth a wrinkled appearance.

A family widespread throughout the tropical regions of both new and old worlds, comprising ten genera and about 80 species, (Walker et al., 1964). All are characterized by having the distal half or third of the tail projecting free beyond the interfemoral membrane, hence the name 'Free-tailed' bats often applied to this family. They also exhibit many other unique family characteristics, their wings being relatively long and narrow, their ears rather thick and leathery and forward directed and rounded in outline, and in many species being convergent across the crown. The eye is large and bright and the upper lip bears many deep folds or wrinkles but it is the heavy square outline of the muzzle and lips which have given rise to the family name of Mastiff Bats, the Greek word 'molossos' referring to a type of dog used by shepherds in ancient times to protect their flocks.

### Genus TADARIDA Rafinesque, 1814

There are about 35 species in this Genus extending from New Mexico to the south west Pacific, through to South East Asia.

### Key to the Pakistan Species of TADARIDA

Size medium. Forearm 47 to 53mm. Ears large, rounded, leathery and forward slanting with tiny tragus. Anterior margins of Pinna almost joining across forecrown. Toes of hind feet with long tufts of bristle like hairs.

... *Tadarida aegyptiaca*

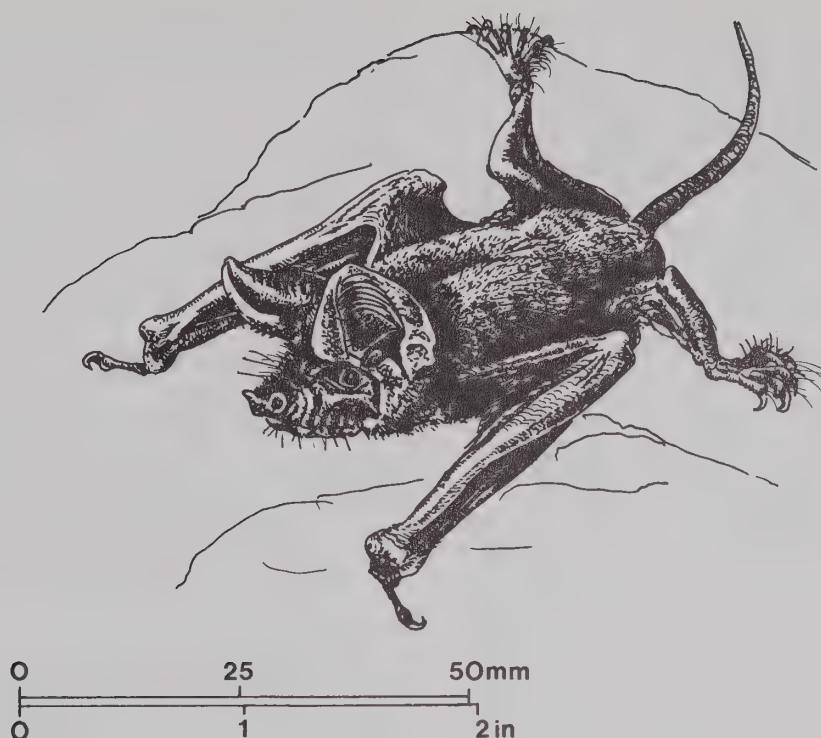


Illustration 12 *Tadarida aegyptiaca*: Egyptian Wrinkle-lipped or Free-tailed Bat. (Based on study specimens from Bombay Natural History Society Collection from Kashmore, Sind.)

## TADARIDA AEGYPTIACA

*Tadarida aegyptiaca* E. Geoffroy, 1818; Egyptian Free-tailed Bat or Wrinkle-lipped Bat (see Illustration 12).

Synonym *Nyctinomus tragatus* Dobson, 1874.

Subspecies *Tadarida aegyptiaca sindica* Wroughton, 1919.

**Description:** This is the only species of this strange family known to occur in Pakistan. *Tadarida teniotis*, recorded from Afghanistan (Kabul) and India (Darjeeling) may possibly occur (Meyer-Oehme, 1965 and Hill, 1936B). The family has so many striking features that they have been given a variety of trivial names as can be seen above. Since the Family Rhinopomatidae is more widespread and better represented in Pakistan and characterized by having a long slender free-tail, it seems less confusing in this book to use the term Wrinkle-lipped Bats to describe members of the genus *Tadarida*.

It is a medium-sized bat with relatively long but narrow wings with the fifth digit being hardly any longer than the second metacarpal (the second digit has one rudimentary phalanx). The body fur is dense, comparatively fine and silky and is grey brown in specimens from Pakistan without any rufescence. The belly fur is slightly shorter and of a paler grey tone. Indian specimens are much browner some being distinctly reddish-brown (Brosset, Part III, 1962). The interfemoral membrane is supported by two long and strongly developed calcars and the hind legs are somewhat thick and fleshy in outline compared with any Vespertilionid Bat of similar size. The tail extends for approximately half its length beyond the base of the interfemoral membrane (see Fig. 13). This free part of the tail is also rather fleshy with fine annulations and it is covered with short sparse bristles. The tail is never as long (or slender) as the tail of the Rhinopomatidae.

The hind feet are very characteristic with the toes somewhat large and fleshy and the outer borders of the first and fifth toes thickly fringed with short stiff whitish bristles whilst there are longer softer hair extending from the distal part of each digit (see Fig. 23). The head is comparatively conspicuous because of the large forward projecting ears whose anterior margins converge but do not quite coalesce across the forecrown. There is a very small squarish shaped tragus and the hind margin of the ear curves round to form an anti-tragus. The ears are sparsely haired and blackish in colour and bear small papillae or wart-like excrescences on their anterior margin. The nostrils are surrounded by fleshy ridges with the muzzle thick and jowly, the upper lips bearing six or seven deep vertical folds so that it has a very characteristic wrinkled appearance. Below the inner margins of the ears and across



Fig. 23 Showing distinctive features of *Tadarida* genus.

- A. Dorsal view of head showing raised nostril with wrinkled lips and forward inclined ears with margins almost uniting on forecrown. Note papillae on anterior margin of ears.
- B. Interfemoral membrane showing relatively thick fleshy leg and tail. Note hairs on rear margin of hind foot and on distal portion of each digit.



the bat's forehead are numerous stiff outward pointing bristles.

When at rest the third digit of the wing is folded back upon itself at the second phalange in the same manner as the wing of the sheath-tailed bats.

In two specimens from Sind the free portions of the tail measured 25mm (1in.), and the total tail length averaged 45mm (1 $\frac{3}{4}$ in.). The head and body length averaged 74mm (2.9in.) and the ear 22mm (0.88in.) with the hind foot 9mm (0.37in.).

Some specimens in summer are practically hairless across the shoulders and also on the ventrum and this may partly be the result of constant friction in their diurnal retreats because of their habit of squeezing into cracks.

**Distribution and Status:** Associated with warmer semi-desert regions, the Egyptian Wrinkle-lipped Bat is not found in mountainous nor well-wooded regions.

In its diurnal roost it is highly selective, favouring deep natural cracks in rock faces or fissures in man-made buildings. They are never seen roosting on open wall surfaces but will inhabit a variety of buildings if suitable crevices are available, and in Pakistan have been found in old tombs and irrigation pump houses as well as in reinforced concrete grain stores. In India they were found by Brosset (1962) in natural rock fissures, a mosque and in roof crevices in a hospital building.

This bat has not been recorded anywhere in Pakistan in the northern regions and appears to have spread eastwards through the warmer southern latitudes of the Persian Gulf and Iran. It has not been recorded outside of southern Sind but has been collected in Dadu District at Bubak, and also at Kashmore in Jacobabad District, both localities on the west bank of the Indus. In April 1972 a sizeable colony was found in Landhi near Karachi roosting in the crevices formed by the expansion joints at the top of supporting pillars in a modern grain store (D. Walton, pers. comm.).

Elsewhere it has only been collected in western central India around Kathiawar, Aurangabad, Bombay and as far

south as Mysore, where it was thought to be thinly distributed (Brosset, 1962). It also appears relatively uncommon and sparsely distributed in Pakistan and this may partly be due to lack of suitable roosting sites. It also appears rare and local in Afghanistan and Iran. In the former country it was collected near Kabul by Meyer-Oehme (1965) but not discovered by Gaisler (1970) in more intensive collecting in eastern Afghanistan. In Iran it was not collected by the Street expedition (Lay, 1967) though it has been collected in Fars Province (D. M. Lay, in lit.). It also occurs in Arabia, Egypt and the Sudan and down to Kenya.

**Biology:** This is a gregarious species in its diurnal roost but often requirements of its biotope limits them to small colonies with space for only six or seven individuals. In the Landhi grain store referred to above there appeared to be two clusters of 20 to 30 individuals (D. Walton, pers. comm.) whilst in India none of the colonies discovered by Brosset (1962) numbered over fifty individuals. However the colony discovered near Kabul in 1964 comprised over 600 individuals (Meyer Oehme, 1965) which seems to be exceptionally large.

They are easy to detect in their colonies because of their strong smell and the fact that they are very noisy even when undisturbed, emitting a low clicking noise which is very characteristic (Rosevear, 1965, and Brosset, 1962). They are shy and immediately retreat deeper into their crevices if approached. Brosset (1963) refers to the character of the *Tadaridae* as 'chasmotropism', whereby they seem to need to have their back and belly in close contact with wood or stone surfaces. It may well be that with their relatively slender narrow wings and large heads that they need to launch into flight by dropping vertically from some height. They are quite agile on the ground and can scuttle sideways or forwards quite rapidly (Walker et al., 1964).

They do not appear to hibernate at any time of the year and are certainly tolerant of high temperatures by day in their diurnal roost. On 25 April at Landhi the temperature inside the roof of the grain store where *Tadarida* roosted was estimated to be at least 106°F (41°C) (D. Walton, pers. comm.).

They are known to be extremely swift and direct flyers but little is actually recorded about their hunting territory or food preferences. It has been observed that they emerge fairly early just at sunset and appear to travel far from their diurnal roost to which they do not return at least during the early hours of the night (Brosset, 1962). They are believed to have an extended hunting territory and to course over open flat spaces rather in the manner of the Hirundines (swallows and martins). Their mouth can open very wide (the wrinkled lips may even facilitate a wider gape) and their strongly developed dentition suggests that they feed principally on larger coleoptera and moths. With their narrow wings they are expert gliders as well as being swift in flight and C. A. Crump (1914) observed them skimming low but at terrific speed over a village tank in Kathiawar. Sometimes these bats hunt high in the air also and the whole colony emerges to hunt within a few moments of each other (D. L. Harrison, 1964).

Studies in the Indian population indicate that in one colony parturition was concentrated in early September and the gestation period was thought to be about 12 weeks, (Brosset, 1962) but nothing has been recorded about breeding in the Pakistan population. It is known that the young are completely naked and hairless at birth and that the female carries them under her wing, there being no room for the normal ventral position of attachment because of its roosting habits of squeezing into narrow cracks. It is not known



Distribution Map 19 Egyptian Free-tailed or Wrinkle-lipped Bat.

whether they make seasonal or local migrations or undergo any periods of inactivity.

**FAMILY VESPERTILIONIDAE – VESPER BATS,  
NOCTULES, MOUSE-EARED BATS,  
PIPISTRILLES, ETC.**

This is a very large family, whether considered in terms of specific diversification, worldwide distribution, or the numerical abundance of its populations, having 38 genera and about 275 species (Walker et al., 1964). There are probably more species within this family than in any other within the Order Chiroptera.

None of them exhibits any very marked individual characteristics but they are usually rather small bats, with an extensive interfemoral membrane which wholly encloses the tail. With one exception, there is no noseleaf, always a quite prominent tragus and the eyes are rather small and poorly developed.

In this family, alone among the Chiroptera, some of the females bear two pairs of mammae. The females generally establish separate maternal colonies and the young are quite naked at birth in contrast to the newly born young of the Rhinolophidae or Emballonuridae.

**Genus MYOTIS Kaup, 1829**

A large genus comprising about 60 species, and widespread throughout both hemispheres. They are found in both Holarctic and subtropical regions. Generally they are characterized by rather elongated muzzles and a long slender tragus (Rosevear, 1965). In North America bats of this genus are referred to as Little Brown Bats and in Europe as Mouse-eared Bats.

In the present state of our knowledge only one species of the Genus is definitely known to occur in Pakistan but three other species are briefly described since their occurrence within Pakistan territory seems highly probable.

**Key to the Pakistan Species of MYOTIS**

Relatively small *Vespertilionid* bats with pointed snouts and upright ears. Tragus long and sharply pointed, dorsal fur stands well out from body, but variable in colour and texture.

Upper tooth row shows six cheek teeth behind the canines with the first two pre-molars minute and rooted well inside the line of the rest of the tooth row. Two pairs of upper incisors (see Fig. 24).

- (i) Size large. Forearm 57–63mm (2.25–2.49in.) no indentation or notch on outer margin of ear.

... *Myotis blythi*

- (ii) Size small. Forearm 37–42mm (1.49–1.6in.). A notch

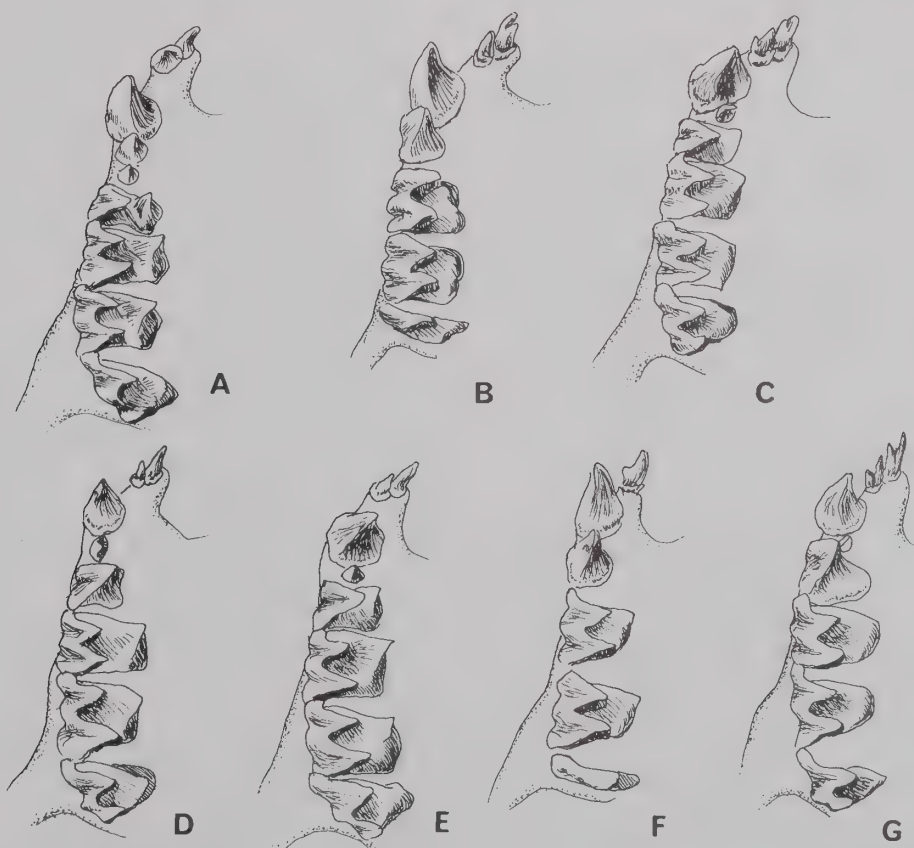


Fig. 24 Showing upper right side maxillary tooth row of various Vespertilionid Bat species.

- A. *Myotis mystacinus*. Note six cheek teeth behind canine.  
B. *Eptesicus serotinus*. Note four cheek teeth behind canine with first pre-molars strongly developed.  
C. *Nyctalus noctula*. Note vestigial first pre-molars with five cheek teeth behind canine.

- D. *Pipistrellus pipistrellus*. Note first pre-molars comparatively conspicuous for this Genus.  
E. *Pipistrellus kuhlii*.  
F. *Otonycteris hemprichi*. Note four cheek teeth with first pre-molars strongly developed and only one incisor.  
G. *Barbastella leucomelas*. Note bifid incisors and vestigial first pre-molars.



on outer or hind margin of ear. Dorsal body fur ginger to reddish orange.

... *Myotis emarginatus*

- (iii) Size very small. Forearm 33–37mm (1.3–1.49in.) Dorsal body fur blackish-brown with scattering of rufous tipped hairs. Small notch or indentation on hind margin of ear – outer margin of wing membrane not hair fringed. Hind foot small, 6mm (0.25in.).

... *Myotis mystacinus*

- (iv) Size small. Forearm 34–37mm (1.33–1.44in.). Dorsal body fur isabelline-brown. No notch or indentation in hind margin of ear. Hind feet relatively large, 10–11mm (0.39–0.43in.) long, with outer margin of wing membrane from tibia hair fringed.

... *Myotis longipes*

SUBGENUS *Selysius* Bonaparte, 1841

### MYOTIS MYSTACINUS

*Myotis mystacinus* Kuhl, 1819; Whiskered Bat.

**Description:** This is a small bat with soft fine body fur which stands well away from the body. Pakistan specimens are very dark in colour, being blackish-brown with a few of the longer dorsal hairs tipped reddish-brown. The belly fur is only slightly paler blackish-grey. The tail is enclosed up to the extreme tip in the interfemoral membrane and there is a longish flexible calcar with a sub-calcarial lobe. The ears are longer and more pointed in outline than in typical *Pipistrellus* and they are naked, being blackish in colour. The rear margin of the ear bears a prominent notch or projection near the base and the tragus is forward curving and banana shaped. The wing membranes are very delicate and blackish in colour. The hallux or first digit is very small and also the hind feet. Out of fifteen specimens from Pakistan the head and body length averaged 42mm (1.6in.) with variation from 40–47mm (1.58–1.83in.) the tail averaged 36mm (1.38in.) with variations from 32–40mm (1.25–1.59in.), the hind foot 6mm (0.25in.) and the ear 13mm (0.5in.). The forearm of five specimens measured on average 35mm (1.37in.) in length.

**Distribution and Status:** This seems to be a Palearctic species which has entered Pakistan only in the northern Himalayan regions in association with Himalayan moist temperate forest and coniferous dry temperate forest.

It is a crevice rooster in its diurnal biotope and favours such locations as cracks or interstices under roofs of buildings. In Europe it is known to roost in hollow trees as well, in the summer months. This appears to be one of the commoner species in well forested areas such as the Murree Hills, the lower Kaghan Valley and even extending into Dir. It has been collected at Shogran, on the outskirts of Dir town, and at Dunga Gali. In adjoining countries it does not appear to have been collected from Afghanistan as yet, but occurs in northern Iran around Gorgan, Azar-baijan and Mazandaran (Etemad, 1968). In India it occurs across the Himalayas from Kashmir to Nepal and the Malaysian archipelago. It extends widely across Europe and southern Russia (Flint et al., 1965).

It is not included in Siddiqi's checklist for Pakistan (1961 and 1970). Though it has not yet been collected from Swat it will probably be found to occur there when more extensive collecting is possible and in well forested localities it is probably not uncommon.

**Biology:** They are observed to emerge fairly early to



Myotis mystacinus Known distribution  
Probable range  
Myotis emarginatus Known distribution  
Possible occurrence

Distribution Map 20 Whiskered Bat.  
Geoffroy's Bat or Notch-eared Bat.

hunt in Europe (Van den Brink, 1967) but in the Murree Hills in mid April, I have observed that they waited until it was almost completely dark. They have a very swift darting flight and are probably adept at weaving between the narrow open spaces in forested areas. Their dentition is weak and they presumably feed mostly on *Lepidoptera* and smaller insects. Their voice has been described as a low buzzing squeak (Southern, 1964).

In Dunga Gali about 20 females were found roosting in the roof of a small disused pump-house. They all appeared to have newly developing embryos (12 April) and were probably a maternal colony. This was at 2400m (7900ft) elevation. On 30 July a colony located under the eaves of the Forest Rest House at Shogran, 2380m (7800ft), also consisted exclusively of females which appeared to have been recently lactating. It is not known whether the rut occurs in the autumn with delayed ovulation or in the spring. In this species the young are not carried by the mother during her hunting flights after the first two or three days, but are left behind in the diurnal roost.

This species definitely hibernates in winter and may seek natural rock caverns with a more equable temperature at this time.

Individuals have been known to live up to 20 years but in the British population the average life expectancy is 4.0 to 4.9 years (Southern, 1964).

### MYOTIS EMARGINATUS

*Myotis emarginatus* Geoffroy, 1806; Geoffroy's Bat or Notch-eared Bat.

Synonym *Myotis lanceus* Oldfield Thomas, 1920.

**Description:** Rather similar to the Whiskered Bat, except averaging larger in size and having a very distinct gingery or reddish-brown dorsal fur. The tragus is rather more pointed

and narrow than in *M. mystacinus* but the rear margin of the ear has a very similar notch or rounded protrusion. The forearm in specimens from Iran and the USSR varied in length from 36–50mm (1.4–1.97in.) with the tail averaging 40mm (1.6in.) and the forearm 38.5mm (1½in.).

**Distribution and Status:** This species is probably better adapted to more arid regions than *M. mystacinus*. It has been collected in widely scattered localities from eastern Iran, including Shastun near Dizak in the extreme south east corner of Kerman Province (Thomas, 1920A). Since this region is only a few miles from the Pakistan border of south east Baluchistan in Chagai region it seems highly probable that this species may occur in this part of Baluchistan also. The Chagai is a remote and sparsely inhabited part of Pakistan where virtually no collecting or study of bats has as yet been attempted. (See Distribution Map 20.)

### MYOTIS BLYTHI

*Myotis blythi* Tomes, 1857; Lesser Mouse-eared Bat.

**Description:** This is a much larger *Myotis* species than either *M. mystacinus* or *M. emarginatus*. The head and body length of specimens from Indian territory varies from 63–70mm (2.49–2.75in.) and the forearm from 53–60mm (2.1–2.3in.). The body fur is generally rather isabelline dorsally and more whitish-buff on the ventrum and the hairs typically stand out from the body being rather woolly or stiffish in texture. The muzzle like others of the genus is sharply pointed and the long narrow tragus is lanceolate in shape extending about half way up the ear. The ear is rather more narrow in outline than the previous two *Myotis* species and there is no trace of any notch on its hind margin.

**Distribution and Status:** The Lesser Mouse-eared Bat is associated with areas of low rainfall but not desert, being often associated with scrub forest and low foothills. In India it has been collected near Simla in the Himalayas as well as at Nasirabad in Rajputana, and Chamba, one of the Punjab hill states (Ellerman and Morrison-Scott, 1951). In Iran it has been collected from around Azarbaijan and the Caspian region (Lay, 1967) and it has apparently been collected in Afghanistan (Harrison, 1964) and Russian Turkestan, western Tianshan and Turkmenia, (though most Russian authors consider it is there, a distinct species *Myotis oxygnathus* (Sokolov, 1963, and Ognev, 1962)). Since all these territories are adjacent to the Himalayan regions of Pakistan and represent comparable vegetational and climatic zones it seems highly probable that this species will be found at least to be a summer visitor in the northern Himalayan zone of Pakistan.

### MYOTIS LONGIPES

*Myotis longipes* Dobson, 1873; Long-fingered Bat.

**Taxonomy:** This bat was previously considered as no more than a subspecies of *Myotis capaccinii* but the investigations of Gaisler (1970) on Afghanistan material shows *M. longipes* to be a distinct and separate species.

**Description:** This is another small *Myotis* with isabelline brown dorsal fur. It has no projections or notches on the hind margin of the ear and can be distinguished from other mouse-eared bats by relatively large feet and a fringe of hairs along the outer margin of the tibia. A typical specimen has the fore-

arm 38–42mm (1.5–1.6in.) in length with the tail 35–40mm (1.37–1.6in.) and the hind foot 11–12mm (0.45–0.48in.). c.f. *M. mystacinus*, hind foot averaging 6mm (0.25in.).

**Distribution and Status:** It has been collected from the south west region of Fars Province of Iran (Lay, 1967) and Islamabad, in Indian Kashmir (Ellerman and Morrison-Scott, 1951). It has been collected from eastern Afghanistan in Lagman Province (Gaisler, 1970). These Indian and Afghanistan locations are relatively close to the Pakistan border, and are in mountainous regions having a similar climate to the dryer inner regions of the Himalayas. It therefore seems highly probable that this species also will be found to be a summer visitor in the northern Himalayan regions of Pakistan when more intensive collecting is possible.

### Genus EPTESICUS Rafinesque, 1820

This is a widespread genus being found in both the new and old worlds. In the Americas they are commonly referred to as Big Brown Bats whilst in Europe they are called Serotines. They are closely similar to *Pipistrellus* in external form and were formerly grouped together under one genus *Vespertilio*, Linnaeus.

Generally they have a relatively slow flapping flight. The females form separate maternal colonies. There are about thirty species of which three appear to occur in Pakistan.

### Key to the Pakistan Species of EPTESICUS

Small- to medium-sized Vespertilionid Bats with short lozenge-shaped tragi and relatively short rounded ears like *Pipistrellus*. They can be distinguished from the genus *Pipistrellus* by having four teeth only behind the canines in the upper (maxillary) tooth row. Thus the first small upper pre-molar which occurs in most *Pipistrellus* species, is always absent, and the single pre-molar is always large and conspicuous (see Fig. 24). When the skull is viewed from in front there are two pairs of upper incisors, the first or inner pair being invariably larger and bicuspid.

- (i) Smaller size. Forearm 33–38mm (1.27–1.5in.). Dorsal fur pale sandy-yellow, or isabelline.  
... *Eptesicus nasutus*
- (ii) Large size. Forearm 52–56mm (2.05–2.2in.). Dorsal fur dark brown, tipped silvery-buff, belly fur greyish.  
... *Eptesicus serotinus*
- (iii) Medium size. Forearm 40–51mm (1.6–2in.). Dorsal fur pale brownish-yellow and ventrum silver-grey.  
... *Eptesicus isabellinus*

### EPTESICUS NASUTUS

*Eptesicus nasutus* Dobson, 1877; Sind Bat, Sind Serotine or Persian Serotine (see Fig. 25).  
Synonym *Vespertilio pellucens*, Thomas, 1906.

**Description:** The Sind Bat is a relatively small Serotine with the body fur of a very distinctive pale sandy-buff or isabelline colour. This pale colour of the dorsal fur at once separates it from sympatric *Pipistrellus* species of similar size, the latter in Pakistan, all being a much darker grey-brown colour. The belly fur is paler greyish-yellow and the fur is rather long and silky, not standing out from the body as in *Myotis* species. The ears are black, practically hairless and roughly triangular in shape. There is a fold along the anterior margin of the ear and there is a prominent lozenge shaped



tragus nearly half the height of the ear. The muzzle lacks any glandular swelling behind the nostrils such as are found in some Vespertilionids. The wings and interfemoral membranes are thin and rather pale brown in colour and the tail which is relatively long, is wholly enclosed in the membrane. There is a well developed calcar with a very small lobe below it.

Four specimens from Pakistan had the head and body length averaging 45.5 mm (1.77 in.) (range 40–51 mm), the tail averaging 43 mm (1.69 in.) (range 42–46 mm), the hind foot 8 mm (0.31 in.) average and the ear 37 mm (1.49 in.) average.

In his key to the species of *Eptesicus*, D. L. Harrison (1964) states that *E. nasutus* can be separated from *E. bottae* by the presence of small warty projections on the wing membrane

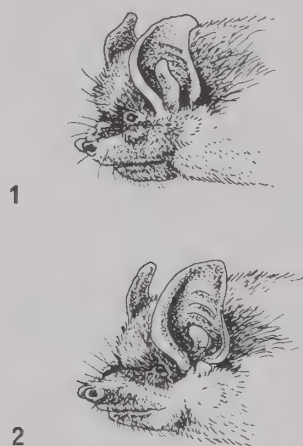


Fig. 25 Showing side view of head.

1. *Eptesicus nasutus*.
2. *Nycticeius pallidus*.

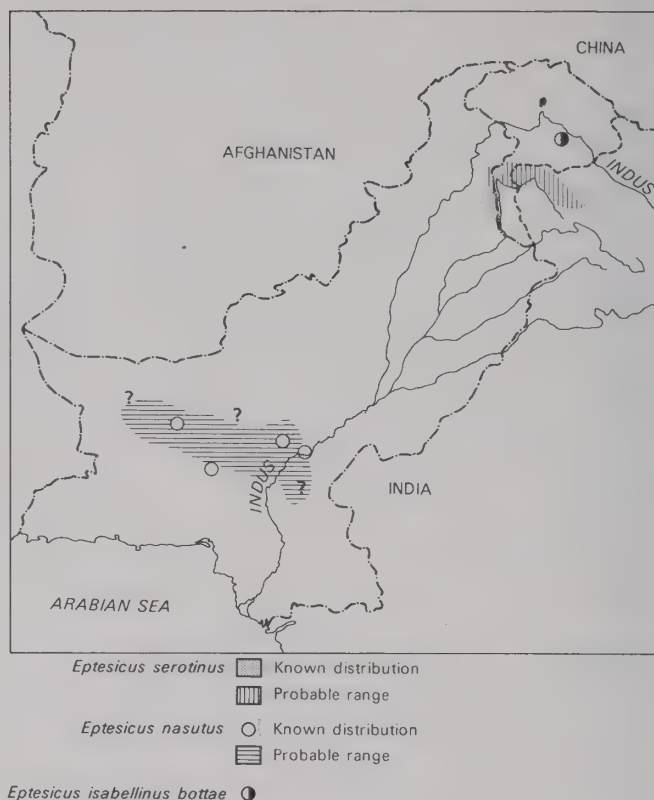
near the body. These have been found to be caused by nematode cysts and also occurred in *E. nasutus* in Afghanistan specimens (Gaisler, 1970).

**Distribution and Status:** This bat has seldom been collected in Pakistan territory and the present limited material available indicates that it is rather rare and locally distributed. It has been collected in southern Baluchistan near Kharan as well as near Rajbar in the southern portion of Kalat State. Also in north western Sind near Shikarpur, but there are no other records for Pakistan.

It is, apparently, well adapted to desert conditions and is confined to warmer sub-tropical latitudes. It is rare in Iran (there is only one record from Khuzistan (Thomas, 1905 and Etemad, 1969)). It has not been recorded from anywhere in India and has only recently been discovered in eastern Afghanistan near Jalalabad (Gaisler, 1970). Elsewhere it has been collected in southern Iraq and Arabia (50 miles north of Aden) (Harrison, 1964). In all these localities it appears to be uncommon.

Ellerman and Morrison-Scott (1951) include the Punjab in its distribution but there are no specimens from there either in the Bombay Natural History Society or British Museum collections so it is not known on what basis this province is included.

**Biology:** Almost nothing is known. Mirza (1970) records that *E. nasutus* has a single offspring in winter but this does not accord with the known breeding habits of other serotines which bear their young in the summer months. In the



Distribution Map 21

Serotine.

Sind Bat or Persian Serotine.

Isabelline Serotine or Botta's Serotine.

Afghanistan specimens collected in mid March and early April the males were sexually active (Gaisler, 1970), which would seem to corroborate young being born in the early summer.

As a genus *Eptesicus* tends to form small colonies in their diurnal roost and usually hangs freely by the hind legs from the roof of some cave or building.

Seasonal local migrations are often undertaken but it is not known whether *E. nasutus* undergoes any hibernation in winter.

## EPTESICUS ISABELLINUS

*Eptesicus isabellinus* Temminck, 1840; Isabelline Serotine. Subspecies *Eptesicus isabellinus bottae* Peters, 1869, Botta's Serotine.

Synonym *Eptesicus bottae ognevi* Bobrinskii, 1918.

**Taxonomy:** There is a single specimen from Astor in Gilgit, in the collection of the British Museum (National History) of a comparatively pale, small Serotine, which is labelled *E. isabellinus bottae*. Ellerman and Morrison-Scott (1951) is followed in this book, for the sake of consistency, because there is still considerable confusion as to the status of various forms of *Eptesicus* found in the Middle East and Central Asia.

D. L. Harrison (1964) considered that *E. isabellinus* was a subspecies of *E. serotinus* and confined to North Africa. He placed *E. bottae* as a distinct species. Gaisler (1970) lists seven subspecies of *E. serotinus* of which four have paler dorsal fur and occur widely in the Middle East or South-central Asia. These subspecies are *E. s. turcomanus* (Eversmann, 1840) which is known to occur in northern Iran and Afghanistan. *E. s. isabellinus* (Temminck, 1840) which he considered as belonging to the North African population, *E. s. pachyomus*

(Tomes, 1857) which is recorded from Rajputana and Kashmir (both in Indian territory) and *E. s. shiraziensis* (Dobson, 1871) from North Western Iran. There has been further review and study of this difficult group both by Hanak Gaisler (1971) and Russian workers (Dr. P. Strelkov, in lit.), from which it appears that there are three distinct species of smaller paler serotines occurring in the region. They are *Eptesicus bobrinskii* (Kuzynkin, 1935), an exceptionally small size serotine with distinctive *Os penis*; *Eptesicus bottae* (Bobrinskii, 1918) which is synonymous with *Eptesicus ognevi*; and finally *Eptesicus serotinus* subspecies *Turcomanus* (Eversmann, 1840) (Dr. P. Strelkov, Zoological Academy, Leningrad, in lit. 1973).

It seems likely that no conclusion can be reached about this single Gilgit specimen until more specimens can be collected but it is probably referable to *Eptesicus bottae ognevi*, since it has the dorsal fur with the roots of the hairs darker and the tips paler, an important distinguishing feature from *E. serotinus turcomanus* (Gaisler, 1970).

**Description:** As indicated above it is a medium-sized Vespertilionid Bat, with long silky dorsal fur which has pale isabelline tips and darker brown bases to the hairs. The ventrum is a paler yellowish grey, but compared with *E. nasutus*, the belly fur is more grey and less pale. Like other Serotines it has a short forward curving tragus and there are only two upper incisors.

The single specimen measures 57mm head and body, with the forearm 42.2mm, the tail 45mm, the hind foot 7mm, and the ear 15mm.

**Distribution and Status:** The Pakistan specimen was collected by C. A. Crump in 1908 from Shenkagarh in Astor district at 3200m (10,500ft) elevation in arid mountain steppe country. *Botta's* Serotine has been collected in extreme northern Iran (Etemad, 1968) and according to D. L. Harrison (1964) in Afghanistan. It also occurs in the frontier zones of Uzbekistan and Tadjikistan in the USSR (Bobrinskii et al., 1965). Its occurrence in Gilgit would therefore seem quite possible. (See Distribution Map 21.)

**Biology:** In Arabia a female has been collected on 22 April containing two embryos (Harrison, 1964).

Ognev's Serotine (*E. bottae ognevi*) is considered widely adaptable in its habitat, occupying both open desert and mountain steppe country (Ognev, 1928). Their flight is low and strong, often accompanied by audible squeaking.

## EPTESICUS SEROTINUS

*Eptesicus serotinus* Schreber, 1774; Common Serotine.

**Description:** This is the largest of the Serotines being only slightly smaller in body size than the Common Desert Scotophil (*S. beathi*). The body fur is very long and silky and the dorsal fur is dark brown with a scattering of silvery-buff tipped hairs especially over the region of the shoulders. The belly fur is shorter and more grey. The naked ears are rather long and narrow, being blackish-brown in colour. There is a conspicuous lozenge shaped tragus. An adult male specimen weighed 58g (2oz) and appeared sexually active on 12 April. The head and body length varies from 60–80mm (2.3–3.2in.) with the tail 58mm (2.25in.). The forearm was 57mm (2.25in.) long in a male specimen from the Murree Hills but in three Kashmir specimens it averaged only 49.5mm (1.9in.).

**Distribution and Status:** This species prefers crevices for

its diurnal roost and males are often found roosting singly but females have been found in small colonies of twenty to thirty. They roost in natural rock fissures as well as in the roofs of buildings. It is a Palearctic species found only in cooler mountain regions of Pakistan and judging from the paucity of collected material is not plentiful in the region. Specimens in the British Museum have been collected from Palgham in the Indian part of Kashmir and there were no known records from Pakistan territory until a solitary male was collected (by me) in 1971 from Dunga Gali in the Murree Hills. It occurs in eastern Afghanistan near Jalalabad (Gaisler, 1970) and also in adjacent Russian territories of Turkestan (Flint et al., 1965). It seems probable therefore that it occurs sparsely in Gilgit, Swat and Chitral also.

This Serotine is widespread throughout Europe extending down to parts of North Africa, Arabia and across to Siberia, Mongolia, China and Korea. It has been collected in Rajputana in India (Ellerman and Morrison-Scott, 1951) as well as Kashmir. In Iran it is mainly confined to the northern regions with a small population in the south east adjacent to the Persian Gulf (Etemad, 1970). (See Distribution Map 21.)

**Biology:** Being widespread and well known in western Europe, the habits of the Common Serotine have been recorded in some detail. They typically emerge rather early to hunt, sometimes while the sun is still shining. Their flight is rather hesitant and heavy with frequent dives to lower levels (Van den Brink, 1967). With rather strongly developed teeth they are capable of tackling a variety of insect prey from larger moths, to *Scarabidae* (Chaffer beetles) and *Diptera* (see Fig. 26).

In the spring the females form separate maternal colonies. The young are generally born in the spring or early summer and are carried by the mother for the first three weeks after birth, unlike the young of *Pipistrellus* species.

The Common Serotine undergoes a prolonged period of hibernation in winter. They are thought to be fairly long lived as a related North American species (*E. fuscus*) has lived for eleven years in captivity (Walker et al., 1964).

## GENUS NYCTALUS Bowdich, 1825

Relatively large Vespertilionid Bats with ear low set and as broad as its height. Tragus mushroom shaped. Wing long and narrow with fifth digit short and barely exceeding third and fourth metacarpals. Tail shorter than head and body length. Prominent lobe below calcar and dorsal hair extending over basal part of interfemoral membrane and on under surface of wing along forearm.

### Key to the Pakistan Species of NYCTALUS (see Fig. 24)

- (i) Size large. Forearm 52–56mm (2.0–2.2in.). Dorsal fur reddish-brown and ventrum brownish-white.  
... *Nyctalus noctula*
- (ii) Size medium. Forearm 43–44mm (1.68–1.71in.). Dorsal fur very dark grey-brown lacking rufescence, ventral fur pale brown.  
... *Nyctalus leisleri*

## NYCTALUS LEISLERI

*Nyctalus leisleri* Kuhl, 1818; Lesser Noctule or Hairly-armed Bat.  
Subspecies *Nyctalus leisleri montanus* Barret-Hamilton, 1906.

**Taxonomy:** Specimens of a medium-sized Noctule



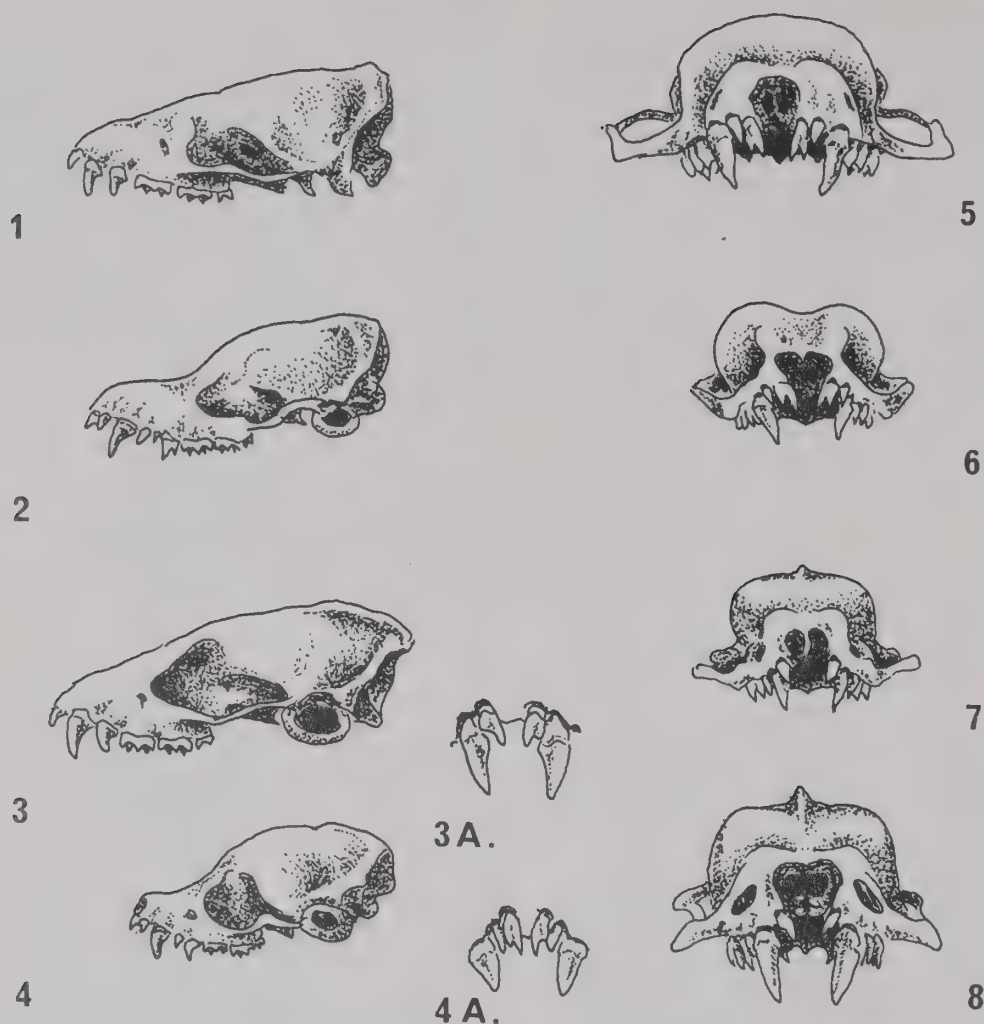


Fig. 26 Showing skulls of various *Microchiroptera*. Lateral views of:

1. *Nycticeus pallidus*.
2. *Myotis mystacinus*.
3. *Otonycteris hemprichi*.
4. *Plecotus auritus*.

Detail of upper incisors when viewed frontally:

3A. *Otonycteris hemprichi*.

4A. *Plecotus auritus*.

Front view of:

5. *Eptesicus serotinus*.
6. *Barbastella leucomelas*.
7. *Nycticeius pallidus*.
8. *Scotophilus beathii*.

collected from the Himalayas (Mussoorie and Kumaon in India) were described as *Pterygistes montanus* by Barret-Hamilton in 1906. Ellerman and Morrison-Scott (1951) showed that the generic name *Nyctalus* has priority over *Pterygistes* and listed *Montanus* as a subspecies of *N. leisleri*. A single specimen collected in Afghanistan by Meyer-Oehme (1965) was identified as *N. l. montanus*. J. Gaisler in 1967 collected one more specimen from Jalalabad (Afghanistan) and after examining the Bombay Natural History Society material, concluded (1970) that the Afghanistan population represented a distinct species *Nyctalus montanus*.

**Description:** This is a medium-sized Noctule of a darker colour than the Common Noctule. The dorsal fur is blackish-brown lacking any rufescence and the belly fur is paler brown. The wings are long and narrow and extend to the ankle of the hind foot in contrast to the Genera *Myotis* and *Pipistrellus* where the wing membrane extends halfway down the outside of the hind foot. The low rounded ear is blackish and naked, both anterior and hind margins being convex when viewed

from the side. There is a low, broad mushroom shaped tragus its anterior margin being sharply concave and posterior margin almost straight. The interfemoral membrane is supported by a strongly developed calcar with a prominent post-calcarial lobe and the last vertebra of the relatively short tail extends beyond the membrane. The dorsal surface of the base of the interfemoral membrane is thickly furred and the ventral surface of the wing is furry beneath the forearm and up to the fifth digit. Three Pakistan specimens averaged 67mm (2.6in.) head and body length, 36mm (1.4in.) tail, 8mm (0.3in.) hind foot, and 10.7mm (0.4in.) ear length.

**Distribution and Status:** This is known to be a migratory species in Europe (Walker et al., 1964) and probably is of erratic occurrence in the northern Himalayan regions of Pakistan. It is not included in either of Siddiqi's checklists (1961 and 1970) but at the beginning of this century two specimens in the British Museum collection were collected from Gharial in the Murree Hills at 2380m (7800ft) and another specimen was collected from Kulululai in Swat Kohistan at 1850m (6000ft) in 1972 by Dr. Walton. It has also been collected



*Nyctalus leisleri* ● Known records

*Nyctalus noctula* ⊗ Known records

Distribution Map 22 Lesser Noctule or Hairy-armed Bat.  
Common Noctule.

from Palgham in Indian Kashmir and from Kumaon as well as Simla further east so it may be fairly widely distributed in the better forested regions of the Himalayas. In Pakistan it appears to be associated with fairly mesic conditions in the Himalayan, moist temperate forest zone. It is probably nowhere very numerous and does not appear to be highly gregarious.

In Afghanistan two specimens have been collected from Pakhtia Province (Meyer-Oehme, 1965) and Jalalabad (Gaisler, 1970). It is apparently rare in Afghanistan also and has not been recorded from Iran.

**Biology:** This species is believed to undergo considerable seasonal migrations and possibly the Pakistan population is only a summer visitor though specimens were collected from the Murree Hills as late as 8 November. The Swat Kohistan specimen was collected on 1 September.

This species emerges to hunt fairly early, like many of the *Pipistrellus* species, often before sunset. They are very swift flyers and appear to hunt particularly for beetles and moths (Walker et al., 1964). The females are believed to assemble in separate maternal colonies, sometimes roosting in hollow trees as well as buildings and two young may often be produced per female. A male collected near Jalalabad on 18 March was found to be sexually active (Gaisler, 1970).

The Lesser Noctule definitely undergoes prolonged hibernation in winter.

## NYCTALUS NOCTULA

*Nyctalus noctula* Schreber, 1774; Common Noctule.

**Description:** This is a large, robust-looking bat, with very glossy fur usually quite bronzey-red when viewed dorsally. The wings are long and narrow and the under surface is thickly furred along the flank up to the elbow as well as in a narrow band extending below the forearm. The top of the

tail extends just beyond the end of the interfemoral membrane and there is a well-developed calcar with lobe. The dorsal surface of this interfemoral membrane is furry around the base of the tail and pelvis.

The nostrils are slightly raised on the tip of the muzzle and the upper part of the muzzle has glandular swellings. The broad blackish ears have a triangular outline along the anterior margin with a low broad mushroom shaped tragus. A single specimen collected from Kohat measured 83mm (3.25in.) head and body length, with the tail 52mm (2.05in.), hind foot 14mm (0.56in.), ear 19mm (0.75in.) and forearm 56mm (2.2in.).

**Distribution and Status:** It is only known in Pakistan from a single specimen (lodged in the Smithsonian Museum) collected from a hollow tree on 28 August from Kohat, North West Frontier Province. In Iran it has only been collected from around the Caspian coastal region and it has not been recorded anywhere from Afghanistan. There are two specimens in the British Museum collection from the eastern part of Indian Kashmir, from Pandritton, and Pompour. Also a third specimen from Kangra in the Punjab Hill States and further specimens from Darjeeling.

To the north it occurs in Russian Turkestan and westwards to Trans-Caucasia (Flint et al., 1965).

Being a Palearctic species it is typically associated with well wooded regions and it appears to be rare in Pakistan. In the summer time it typically occupies hollow trees for its diurnal roost and occasionally buildings. (See Distribution Map 22.)

**Biology:** The Common Noctule is a noisy bat both in its diurnal roost and in its hunting at night time, when its voice is clearly audible as shrill squeaks. They are particularly quarrelsome and noisy towards evening before they emerge to hunt (Ognev, 1928). They are gregarious in their diurnal roost and the females form separate maternal colonies.

Like the Lesser Noctule they are seasonally migratory, an individual in Germany having been recovered 755 km (470 miles) north of its winter hibernating site (Walker et al., 1964).

This specimen has a powerful and swift flight often darting low to the ground and they are known to be fond of *Scarabidae* (cockchafer beetles).

The female produces one to two young after a gestation believed to last 50–70 days (Walker et al., 1964) and the young attain adult dimensions in about seven weeks.

## Genus PIPISTRELLUS Kaup, 1829

Widely distributed throughout the northern hemisphere and extending to Africa, India and south east Asia, New Guinea and Australia. About sixty different species have been named (Rosevear, 1965) of which seven appear to occur in Pakistan.

As indicated below, they lack any very distinctive features and the taxonomy of this genus has led to much difference of opinion especially with respect to Indian representatives (Lay, 1967 and Gaisler, 1970).

Generally they are characterized by their habit of emerging to hunt earlier in the evening than most other bat species, as well as by their erratic and jerky flight. They usually seek confined places such as crevices for their diurnal roost but these can be in a variety of situations such as buildings, hollow trees, caves and under loose rocks or under flakes of bark.

Small- to medium-sized Vespertilionid Bats with forearm generally under 40mm (1.56in.). In their external features they are in no way different from the Genus *Eptesicus*.



The tail is generally wholly enclosed in a well developed interfemoral membrane and there is a small lobe below the calcar. The wing membrane terminates at the base of the first digit of the hind foot. The ears are widely separated, smallish and roundly pointed with the tragus relatively short and bluntly shaped, often forward curving.

In the upper jaw there are five cheek teeth behind the incisors with the first pre-molar being minute, usually invisible from outside the tooth row, and in some species very difficult to discern. There are two pairs of upper incisors of which the inner pair is usually bifid. The skull lacks any helmet-like projection in the occipital region.

### Key to the Pakistan Species of *PIPISTRELLUS*

- (i) Small size. Forearm 27–31mm (1.1–1.23in.). Outer margin of ear below tip, concave. Tragus narrow. First pre-molar clearly visible from outside tooth row (see Fig. 26). Inner or first pair of upper incisors markedly bifid.  
... *Pipistrellus pipistrellus*
- (ii) Small size but larger than *P. pipistrellus*. Forearm 29–31mm (1.13–1.21in.). Anterior pre-molar entirely inside tooth row. Dorsal fur dark reddish-brown. Outer margin of ear below tip, straight.  
... *Pipistrellus coromandra*
- (iii) Very small size. Forearm 27–29mm (1.05–1.13in.). Only four upper cheek teeth with first pre-molar lacking. Dorsal fur dark smoky brown.  
... *Pipistrellus mimus*
- (iv) Large size. Forearm 37–40mm (1.48–1.6in.). Tragus rather narrow. Dorsal fur reddish-brown. No white border on rear margin of wing.  
... *Pipistrellus ceylonicus*
- (v) Medium size. Forearm 33–37mm (1.29–1.44in.). Both upper incisors unicuspid with the outer one being very small. First pre-molar not visible from outside of tooth row (see Fig. 26). Dorsal fur rather pale greyish-brown. Conspicuous white border to rear edge of wing between heel and fifth digit.  
... *Pipistrellus kuhli*
- (vi) Medium size. Forearm 33–35mm (1.26–1.36in.). Both upper incisors roughly equal in size with inner pair lacking any trace of a secondary cusp.  
... *Pipistrellus babu*
- (vii) Only one pair of incisors in the upper jaw or if outer pair present they are minute with the tips barely reaching the cingulum of the inner pair. Ventral fur very pale whitish-grey. Dorsal fur hoary with scattering of silver tipped hairs.  
... *Pipistrellus dormeri* Synonym *Scotozous dormeri*

### *PIPISTRELLUS PIPISTRELLUS*

*Pipistrellus pipistrellus* ♀ Schreber, 1774; Common Pipistrelle.

**Description:** This rather small Pipistrelle has pale smoky-brown dorsal fur in specimens from the Himalayas. The belly fur is only slightly lighter brown and the body fur is fine, silky and not woolly. The wing is rather narrow, the fifth digit always being considerably longer than the metacarpal bone of the fourth digit. The wing membrane is blackish and opaque. There is a prominent lobe below the calcar and the hind feet are relatively small and delicate. The ears are slightly tapered and rounded at the tip, with the tragus 'banana' shaped,



*Pipistrellus pipistrellus* ○ Occurrence  
▨ Probable range  
*Pipistrellus dormeri* ● Occurrence (Synonym *Scotozous dormeri*)  
▨ Probable range

Distribution Map 23 Common Pipistrelle.  
Dormer's Bat.

having its tip bluntly rounded and forward curving.

As indicated in the key the first upper pair of incisors are bifid and the outer incisor is half the height of the inner one.

Two Gilgit specimens had the forearm varying from 27–33mm (1.1–1.27in.) with the head and body length 42–45mm (1.6–1.74in.), tail 33–34mm (1.29–1.33in.), hind foot 7mm (0.25in.) and ear 11–12mm (0.42–0.47in.) in length.

**Distribution and Status:** The British Museum has one specimen collected from Pandritton in Kashmir, at the beginning of this century, and two other specimens collected near Gilgit town by the University of Maryland expedition in 1965 at 1450m (4770ft) elevation. It is not included in Siddiqi's checklist (1960 and 1970). There are no other records of its occurrence in Pakistan but it could be more common than these records indicate as there has been very little collecting in Gilgit. Moreover, in Afghanistan it appears to be fairly numerous in the north western regions of Nuristan, Balkh and Faryab Provinces (Meyer-Oehme, 1965 and Gaisler, 1970). It has also been collected from Russian Turkestan in territories adjacent to Pakistan (Flint et al., 1965). It has also been collected from northern Iran around the Caspian coastal area (Etemad, 1969). Elsewhere it occurs throughout Europe, Russia, Japan and Formosa (Ellerman and Morrison-Scott, 1951).

**Biology:** Though occurring in mountainous regions in Pakistan, this species seems particularly to be associated with human habitations and villages and probably favours the chinks and crevices available in roofs or walls for its diurnal roost. Generally they occur in small clusters of three to four.

They hibernate in winter and there may be some seasonal migration to more favourable hibernating localities.

They are swift and erratic in flight and frequently search the air around buildings. They have been observed using their forearm to strike down larger insect prey as well as cupping insects in their interfemoral membrane while delivering the

'coup de grace' with their teeth. Echolocation is used in hunting, ultrasonic noises being emitted through the open mouth (Southern, 1964). As indicated above, they invariably emerge to hunt very early in the evening, sometimes before the sun has set and they generally spend a large part of the night resting in their diurnal roost. Generally they have two active periods of hunting during the night, each of only one or two hours duration.

Females form separate maternal colonies, the young are born in the early summer and the mothers only carry their young when out hunting for the first two or three days after birth. The young are naked at birth, open their eyes on about the seventh day and are capable of making their first independent flight on about their twentieth day of life (Southern, 1964). In a large sample from northern Afghanistan the majority of females dissected in May carried twin foetuses and one individual had three embryos (Gaisler, 1970).

They appear to reach sexual maturity during the first year of life and to live in the wild from four to eight years (Walker et al., 1964).

### PIPISTRELLUS COROMANDRA

*Pipistrellus coromandra* Gray, 1838; Indian Pipistrelle.

**Description:** The exact status of *P. coromandra* is not clear as there are no very complete descriptions of the species (Khajuria, 1952, Brosset, 1962 and Gaisler, 1970). It appears to be a significantly bigger Pipistrelle than *P. pipistrellus* with the dorsal fur blackish-brown and the tips of the hairs slightly rufescent. The belly fur is a slightly paler brown. There is a small lobe below the calcar and the tragus is forward curving and bluntly rounded.

In a series of ten specimens from Chitral and seventeen specimens from Saidu-Sharif in Swat, the head and body averaged 43mm (1.7in.) (range from 41–46mm (1.6–1.8in.)) with the tail averaging 35mm (1.37in.) (32–37mm (1.25–1.44in.) range). The hind foot averaged 7mm (0.25in.) in length and the ear 11mm (0.42in.) with the forearm 32mm (1.25in.) (31–33mm (1.21–1.29in.) range). These Pakistan specimens, and also those from Jalalabad in eastern Afghanistan (Gaisler, 1970) appear to average slightly larger than the population from central India (Brosset, Part III, 1962).

**Distribution and Status:** *P. coromandra* was collected by the University of Maryland expedition in 1965 from Chitral town at 1400m (4800ft) elevation sheltering in crevices of the roof of the civil hospital, and also from Dir. They were seen to be fairly plentiful in the vicinity of both towns. Dr. Walton collected seventeen roosting behind verandah blinds on 29 August 1972 from Saidu-Sharif in Swat. With the limited knowledge of the exact status and distribution of any *Pipistrellus* species in the mountain regions of northern Pakistan, it is impossible to make any generalisation about the status of this species, but it seems to have invaded the Himalayas from the south whereas *P. pipistrellus* has a more northerly distribution.

In Afghanistan this species was found to be quite plentiful in the Kabul River valley around Jalalabad and extending northwards into the Kunar valley (Gaisler, 1970) and is therefore probably widespread in the lower part of Chitral (from which the Kunar River flows) as well as Dir.

Elsewhere it occurs in peninsular India and Ceylon and has been collected in the Himalayas from Kumaon eastwards to Sikkim and Burma (Ellerman and Morrison-Scott, 1951). It also occurs in southern China and Indo-China.



*Pipistrellus coromandra* ○ Known distribution  
▨ Probable range

Distribution Map 24 Indian Pipistrelle.

**Biology:** Little is recorded about the habits of this Pipistrelle except that they hide in crevices during the day either in cracks under roofs or in walls of buildings or occasionally in hollow trees and they seem to form sizeable colonies (Gaisler, 1970).

Brosset (1962) observed that the Indian Pipistrelle emerges fairly early at sunset to hunt and stays out later in the morning than other bat species in western India. Specimens collected a few minutes after sunset in south India already had their stomachs crammed full of small flies (Brosset, 1962). Possibly this species undergoes irregular hibernation in southern or more tropical latitudes though the Pakistan population would probably undergo fairly prolonged winter hibernation.

### PIPISTRELLUS MIMUS

*Pipistrellus mimus* Wroughton, 1899; Indian Pygmy Pipistrelle.

**Description:** Easily identified from all the other *Pipistrellus* species by its small size, this is also a very dark brown in body colour with the belly fur only slightly paler brown. The widely spaced ears are roughly square in outline when viewed from the side with the forward curving tragus about half the height of the ear. The base of the interfemoral membrane around the lower pelvis is thickly furred on its dorsal surface. Three specimens from Pakistan averaged 36mm (1.40in.) head and body length with the tail 32mm (1.25in.) (30–35mm (1.2–1.3in.) range), hind foot 3mm (0.13in.) and ear 5mm (0.19in.). The forearm averaged 28mm (1.09in.).

**Distribution and Status:** In the better wooded regions of the Indus plains this is one of the most abundant bat species in Pakistan. It is particularly common around gardens in the older towns of the Punjab. It occurs throughout Sind from Karachi to the north but avoids extensive desert areas such as the Sibi Plain, or Cholistan. It has been collected in





*Pipistrellus mimus*

Distribution Map 25 Indian Pygmy Pipistrelle.

the Malakand, in the North West Frontier Province, though there is no evidence yet of its occurrence in Baluchistan and Brosset (1962) found that it avoided mountainous areas in India.

They select a variety of situations for their diurnal retreat, preferring any sheltered crack between bricks, behind pipes, under roof tiles or even in hollow trees.

It has been collected in Afghanistan at Kala-i-Shahi in Nangarhar Province (Meyer-Oehme, 1965) and specimens from Iran collected from Shiraz in 1919 were assigned to this species but there have been no records since (Cheesman, 1920, Lay, 1967) and this may have been a case of confusion with *P. pipistrellus*. Elsewhere it occurs throughout Ceylon, India and across to western Burma.

**Biology:** This is one of the earliest bat species to emerge to hunt in the evening. It favours the narrow spaces between trees and its darting erratic flight is very characteristic. In my garden in Khanewal, south west Punjab, individuals seem to frequent particular territories in the spring and early summer and within an area of three acres there appeared to be nine individuals in one year each regularly seen hunting about a particular space.

They can be seen hunting at all months of the year but individuals probably undergo short periods of partial hibernation at some time during the winter. On 5 February a cluster of three were found in a torpid condition under a canvas tarpaulin. They could be handled without attempting to escape but became active after several hours. Both sexes seem to roost together. Brosset (Part III, 1962) found this species in deep hibernation in December at Anand (north west India) but other individuals were seen on the same date actively hunting.

In Ceylon females have been found with one and two young in March, May and December (Phillips, 1922). Nothing has been recorded about the reproduction of the Pakistan population but it is probable that most young are born in the spring and early summer since insect life is sparse in most regions in the winter. In Khanewal I found two young *P. mimus* on 26 May behind a verandah blind. Though their fore-

arm measured only 23mm (0.88in.) and head and body length only 30mm (1.2in.) yet they were able to fly quite actively and appeared independent. They could not have been more than one month old at the time. Females form separate maternal colonies and two young were commonly observed being carried by one female in Ceylon (Phillips, op. cit.). The young are naked, pink and rather helpless at birth. Phillips (1927) gives an interesting account of a female *P. mimus* displaying strong maternal instincts. Its young, which had fallen out of a hole onto the ground, was carried into a lighted room whereupon the mother entered through the window and settled beside its flightless young which immediately commenced to suckle.

### PIPISTRELLUS CEYLONICUS

*Pipistrellus ceylonicus* Kelaart, 1852; Kelaart's Pipistrelle (see Illustration 13).

**Description:** This is a relatively large Pipistrelle and the dorsal fur has more of a rufescent tinge than Kuhl's Pipistrelle. It can readily be distinguished from the Indian Pigmy Pipistrelle by its greater size. The forearm averaged 35mm (1.35in.) in five specimens from Pakistan, with the head and body averaging 51mm (2in.) (48–56mm (1.8–2.2in.) range), the tail 38mm (1.5in.) (36–44mm (1.40–1.72in.) range), the hind foot 9mm (0.35in.) and the ear 12mm (0.47in.). There is no trace of a white border to the rear edge of the wing membrane as in *P. kuhl*. The muzzle in this species often has glandular swellings between the eyes and the nostrils.

**Distribution and Status:** This Pipistrelle seems to be more common in warmer southern latitudes in the Indus plain and is particularly abundant around Karachi and in Thatta District of Sind. It has however been collected from Lyallpur (Taber, 1967) and Khanewal. It seems to avoid mountainous regions and has not been collected from Baluchistan or the North West Frontier Province, though it is by no means uncommon throughout the Canal colonies and better wooded regions of the Punjab.

In India, Brosset (1962) considered it the most abundant



*Pipistrellus ceylonicus*

Distribution Map 26 Kelaart's Pipistrelle.

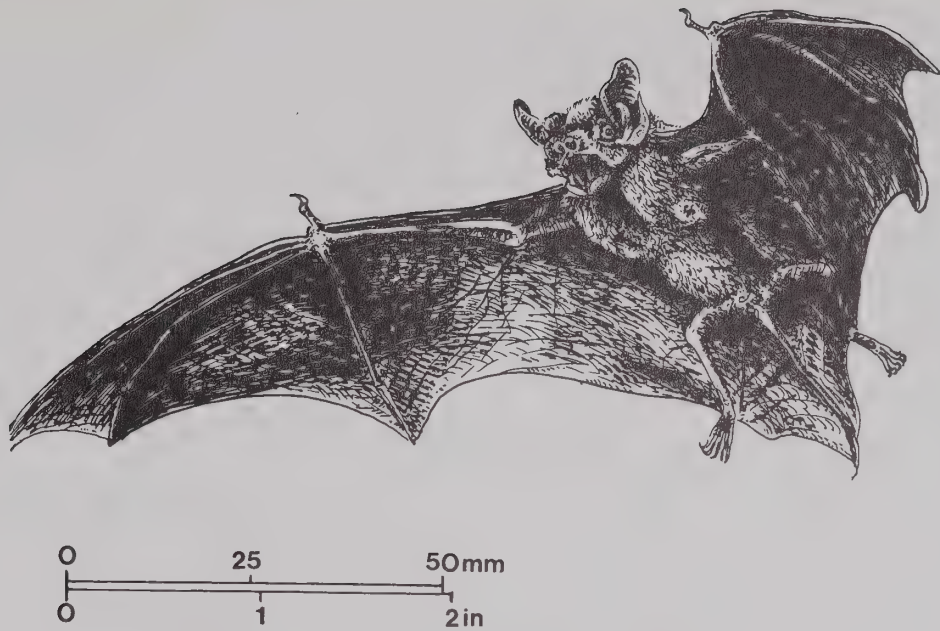


Illustration 13 *Pipistrellus ceylonicus*: Kelaart's Pipistrelle.  
(Based on live caught adult female specimen, Khanewal, Punjab.)

bat species in western and central India. It is also common in Ceylon and Ellerman and Morrison-Scott (1951) included Burma and Indo-China in its range. This South East Asian population has now been assigned to *P. tenuis*, Temminck, 1840 (Medway, 1969).

In its diurnal retreat, it occupies cracks and crevices in buildings, natural caves, crevices down open wells and in old tombs and even under verandah 'chicks' (roller blinds). In all such places it seems to need bodily contact both dorsally and ventrally.

It is probably the most plentiful bat species in southern Sind but not so widespread as the Pygmy Pipistrelle further north.

**Biology:** In its flight Kelaart's Pipistrelle appears faster than the Pygmy Pipistrelle which can often be seen hunting in the same vicinity. An individual that I observed in a house in Karachi in late September, emerged before dusk from a crevice inside the living room, behind the wainscoting. It returned to this same hiding place after about one hour's feeding and repeated this on two consecutive evenings.

In western India young are born mainly in the autumn (Phillips, 1922 and Brosset, 1962) and one or two young are produced. As with other *Pipistrellus* species, the young are blind and naked at birth but grow very rapidly and by about the age of three weeks are capable of independent flight.

Brosset (1962) observed hibernation in this species in south and central India, at all seasons of the year. Phillips (1922) observed in Ceylon that both sexes roosted together at all times of the year.

**PIPISTRELLUS KUHLI**

*Pipistrellus kuhli* Kuhl, 1819; Kuhl's Pipistrelle.

**Description:** This is a fairly large Pipistrelle, distinguished from Kelaart's Pipistrelle by its paler brown body fur and the white margin to the wing membrane extending between the

heel and the fifth digit. The dorsal fur is usually a rather grey-brown and the belly a paler greyish-yellow, significantly paler and less brown than the ventrum of *P. ceylonicus*. It also averages slightly smaller in size than the latter. Nine individuals from Pakistan had the forearm averaging 35mm (1.36in.) varying from 32–36mm (1.25–1.4in.) with the head and body averaging 49mm (1.9in.) (45–55mm (1.75–2.15in.) range), the tail averaging 40mm (1.57in.) (36–43mm (1.4–1.7in.) variation), the hind foot 7mm (0.25in.) and the ear 14mm (0.5in.).



*Pipistrellus kuhli* Known distribution  
Probable range

Distribution Map 27 \* Kuhl's Pipistrelle.



In the hand, the first pair of incisors are unicuspid in the upper jaw with the second incisor very small and only just reaching to the cingulum of the first pair. The first pre-molar is barely visible from outside the tooth row (see Fig. 24).

**Distribution and Status:** Kuhl's Pipistrelle is more widespread than the Pygmy or Kelaart's Pipistrelles in the Indus plain, being better adapted to open desert areas and not so dependent upon trees. However it never seems to be so numerically abundant as the two former species.

It has been collected in Baluchistan at Panjgur roosting in kharezes, and at Darzi Chach in a thatched roof. It has been collected around Kashmore in Jacobabad district in Sind, as well as Hyderabad, Mirpur Sakro, Pithoro and Sukkur. It does not appear to be so common in the Punjab though it has been collected in Lyallpur, Muzaffargarh and Rajanpur in Dera Ghazi Khan District. There are no records for the northern Punjab or the North West Frontier Province though it has been collected from Jalalabad in eastern Afghanistan at the same latitude as the Vale of Peshawar. It is apparently absent from India though it spreads throughout southern Iran (Etemad, 1969). In Afghanistan it also occurs throughout the south eastern region having been collected around Kandahar, as well as Dilaram and Khost (Meyer-Oehme, 1965). Elsewhere it extends throughout the Mediterranean region including North Africa through Arabia, Iraq and into Trans-Caspia in the USSR (Van den Brink, 1967 and Bobrinskii et al., 1965). It typically chooses crevices and chinks in buildings or natural rock fissures for its diurnal roost.

**Biology:** They are gregarious in their diurnal roost though the size of individual colonies must depend upon the limited space available in such crevices.

Observations in the Lebanon and Iraq indicate that the rut takes place in autumn with ova being fertilized in the spring and one to two young being born in April or May (D. L. Harrison, 1964).

It is a swift flyer and typically emerges fairly early in the evening to hunt.

Nothing is recorded about the hibernation of this species.

#### PIPISTRELLUS BABU

*Pipistrellus babu* Thomas, 1915; Himalayan Pipistrelle.

**Description:** This Pipistrelle is listed by Ellerman and Morrison-Scott (1951) as a distinct species. It was first described by Oldfield Thomas (1915) on the basis of specimens collected from Kumaon in the Punjab Himalayas. However his description is far from complete and the exact relationship of this Pipistrelle needs further clarification.

According to the series in the British Museum, it is a medium sized pipistrelle with the forearm measuring 33–34mm (1.28–1.3in.), head and body 51mm (2in.), tail 31mm (1.24in.), hind foot 6mm (0.25in.) and ear 10mm (0.38in.).

The body fur in specimens from the Murree Hills is quite a dark brown and lacks any rufescence. The belly fur is slightly paler brown. There is a prominent lobe below the calcar and the dorsal fur extends to the base of the interfemoral membrane around the base of the pelvis, as in *P. mimus*. The rear edge of the wing membrane is not white bordered and it can be distinguished from *P. kublii* by the larger size of the second or outer incisor in the upper jaw which is three-quarters of the length of the inner. The first pre-molar is clearly visible from outside the tooth row according to Ellerman and Morrison-Scott (1951).



Distribution Map 28 *Pipistrellus babu* Known occurrence  
Probable range

Distribution Map 28 Himalayan Pipistrelle.

**Distribution and Status:** There is a small series in the British Museum collection from Gharial in the Murree Hills, collected at 2380m (7800ft) in pine forest. A single specimen assigned to this species was collected near Jalalabad in Afghanistan (Meyer-Oehme, 1965) and its distribution is also given as Kumaon, the Punjab Hills, Nepal, Sikkim, Assam and the central province of India (Ellerman and Morrison-Scott, 1951).

Nothing can be said about its distribution and status in Pakistan in the light of the present limited material collected. It has not been identified in Iran or the USSR and none of the Pipistrelles collected by the Czechoslovak expedition to Afghanistan were assigned to this species (Gaisler, 1970).

**Biology:** Nothing special has been recorded about the habits or ecology of this species.

#### PIPISTRELLUS DORMERI

*Pipistrellus dormeri* Dobson, 1875; Dormer's Bat.  
Synonym *Scotozous dormeri* Dobson, 1875.

**Taxonomy:** Miller (1907) in his Taxonomic Review of the Chiroptera, retains *Scotozous* as a separate genus from *Pipistrellus* because the upper, outer incisor is very minute in *dormeri*, its tip barely reaching the cingulum of the inner. Ellerman and Morrison-Scott (1951) combine *Scotozous* with *Pipistrellus*, but the latest view seems to be that *Scotozous* should be retained (J. E. Hill, British Museum, in lit., 1973).

**Description:** This bat has the same general ear and tragus shape, relatively small size and wing shape of typical Pipistrelles but differs in two striking features. Its body fur is markedly pale on the ventrum being almost white. All other Pipistrelle species in the Indian subcontinent have brownish-grey belly fur. Secondly, it has only one pair of incisors in the upper jaw or if a second outer pair is present they are much reduced in size and almost vestigial. The dorsal fur is also

hoary in appearance with the distal portion of the hairs silvery grey.

A specimen collected from Charwa in Sialkot District had the dorsal fur dark grey-brown basally but the tips were silvery grey. It had the head and body length 52mm (2.03in.), tail 38mm (1.5in.), hind foot 9mm (0.36in.) and ear 13mm (0.5in.). Specimens from Kathiawar (Anand) in India had the tail averaging 35mm (1.37in.) and the forearm also averaging 35mm (1.37in.) (34–36mm (1.35–1.4in.) range).

**Distribution and Status:** In recent years it has only been recorded from Kutch and Kathiawar in north west India (Brosset, Part III, 1962). A single specimen was collected in 1965 by the University of Maryland expedition from Sialkot District close to the Indian border and it seems possible that it may enter Pakistan territory around south east Sind as well as in the Himalayan foothill zone, though as yet this is the only record for the species in Pakistan and it must be considered rare and of restricted distribution. (See Distribution Map 23.)

**Biology:** The Sialkot specimen was netted near a grove of mango trees. Brosset (1962) collected specimens roosting under roof tiles and observed that it did not emerge to hunt until about ten minutes after sunset. They were noisy in their diurnal haunts (Brosset, op. cit.).

Nothing else is recorded about their habits, or ecology.

#### Genus BARBASTELLA Gray, 1821

Ears joined across forehead at the base of their anterior margins by a low ridge. The posterior margin somewhat notched with the tragus long and slender. Tip of tail extends just beyond interfemoral membrane (see Fig. 19). Nostrils are situated on upper surface of nose-pad. Body fur very blackish basally but hoary tipped.

#### Key to the Pakistan Species of BARBASTELLA

- (i) Forearm 40–43mm (1.6–1.72in.). Ears large and broad and joined across forehead by ridge of skin. Tragus triangular at posterior base, tapering to a slim point. Body fur very black basally with dorsal hairs hoary tipped. Lower ventrum whitish.  
... *Barbastella leucomelas*

#### BARBASTELLA LEUCOMELAS

*Barbastella leucomelas* Cretzschmar, 1826; Asian Barbastelle or Asiatic Wide-eared Bat.

Synonym *Barbastella darjelingensis* Hodgson, 1855.

**Description:** This is rather a small and delicately built bat with a very striking body colour. The dorsal fur is long and silky and of a blackish-grey colour basally, with the extreme tips of the hairs a pale golden brown giving it a hoary appearance. The belly fur is a paler greyish-brown. The ears are large and conspicuous being rather squarish in outline and forward slanting. The tragus is half the height of the ear and triangular in shape. The posterior margin of the ear lacks any projections or notches as in *Barbastella barbastellus*. There is an extensive interfemoral membrane with a rather small calcar and inconspicuous lobe below the calcar. The dorsal surface of the membrane is sparsely haired and shows two dark lines or veins extending from the heel of the hind foot up to the base of the pelvis (see Fig. 19).



*Barbastella leucomelas* ○ Known occurrence  
▨ Probable range

Distribution Map 29 Asian Barbastelle or Asiatic Wide-eared Bat.

There are two incisors in the upper jaw, the inner pair being bi-fid and the outer incisor just reaching the height of the lower cusp of the first pair (see Fig. 24). There is a minute first pre-molar inside the tooth row which is invisible from without.

A single specimen from Gilgit measured 55mm (2.19in.) head and body length with the tail 49mm (1.9in.), hind foot 8mm (0.3in.) and ear 17mm (0.69in.). The forearm measured 43mm (1.65in.). A specimen from Dunga Gali, measured from a dried skin, had the head and body 60mm (2.37in.), tail 45mm (1.75in.), hind foot 6mm (0.23in.), ear 17mm (0.66in.) and forearm 40mm (1.57in.). The average forearm length of Arabian specimens is given as 37–38mm (1.48–1.5in.) by D. L. Harrison (1964) but the Russian population has the forearm averaging 40.6–44.5mm (1.59–1.75in.) (Ognev, 1928) and the northern Himalayan population which occurs in Pakistan is also likely to average larger than Arabian specimens.

**Distribution and Status:** Present limited evidence indicates that this bat is associated with forest in the northern mountain regions, either Himalayan moist temperate or dry coniferous forest. Since this species is not gregarious in its diurnal roost it is never very plentiful throughout its range and the paucity of Pakistan specimens indicates that it is uncommon if not rare. Ellerman and Morrison-Scott (1951) include Gilgit and the Punjab within its range on the basis of reports by Blanford but there are no specimens in the British Museum or Bombay Natural History Museum collections from Gilgit. However a specimen was collected at Dunga Gali in 1907 at 2350m (7800ft) and another specimen was collected in 1965 by the University of Maryland expedition from Naltar in Gilgit in spruce forest (*Picea morinda*) both regions at about 2450m (8000ft) elevation. Siddiqi does not include this species in either of his checklists (1961 and 1970).

It was collected from Afghanistan in Paktia Province (Meyer-Oehme, 1965) and from several localities in northern Iran (Etemad, 1969). Elsewhere it occurs in Russian Turkestan.



Chinese Turkestan and Trans-Caucasia (Bobrinskii et al., 1965) and southern China to Japan and Indo-China. In India it occurs in Darjeeling, Nepal, Sikkim and the Bhutan Duars.

**Biology:** This is a non-social species generally roosting and hunting singly. It favours crevices under bark and tree hollows for its diurnal roost in summer, but has been collected in caves and tunnels in the USSR (Ognev, 1928) and in a mine-shaft in Iran (Lay, 1967). Both the Pakistan specimens were collected in late summer and nothing is recorded about their breeding biology in the region.

The flight is described as rather heavy and fluttering sometimes low to the ground and at other times quite high, (Walker et al., 1964) and it apparently does not emerge to hunt until dusk. The young are born rather early in the year and often twins are produced according to Ognev (1928).

### Genus NYCTICEIUS Rafinesque, 1819

Comprising fourteen species distributed over most of North America, and extending to Africa, India and down to Australia and Papua. They are generally known as Evening Bats or Vesper Bats in North America. No species of the Genus is represented in Europe.

Relatively small Vespertilionid bats, externally similar to the Serotines (*Eptesicus* Genus) but distinguished by having only one pair of incisors in the upper jaw and only four upper cheek teeth (pre-molars and molars). They have short rounded ears with a short half moon shaped tragus which is comparatively longer than any *Pipistrellus* species.

### Key to the Pakistan Species of NYCTICEIUS

- (i) Forearm 34–37mm (1.33–1.44in.). Dorsal fur pale isabelline brown. Outer pair of incisors and first pre-molar in upper jaw absent (see Fig. 26).  
... *Nycticeius pallidus*

### NYCTICEIUS PALLIDUS

*Nycticeius pallidus* Dobson, 1876; Yellow Desert Bat (see Fig. 25).

Synonym *Scoteinus pallidus* Dobson, 1876

**Description:** This bat closely resembles *Eptesicus nasutus*, the Sind Bat, in size and external appearance but the latter species has two pairs of incisors in the upper jaw. Pakistan specimens can be further distinguished from *E. nasutus* by the dorsal fur being a slightly darker brownish buff and also by their larger size. A series of sixteen specimens from Sind and the Punjab had the head and body length averaging 54mm (2.10in.) (50–59mm (1.95–2.3in.) range), the tail averaging 37mm (1.44in.) (31–41mm (1.24–1.6in.) range) with the hind foot averaging 8mm (0.3in.) and the ear 13mm (0.5in.).

The wing and tail membrane appears delicate and opaque grey-brown in colour with radiating lines of darker impunctations across the interfemoral membrane. There is a well developed calcar with a prominent lobe.

The body fur is fine and silky with the belly fur a paler isabelline or brownish-white colour. The ear is low set and rather square in outline with the tragus backward curving with the anterior margin indented or slightly concave and about half the height of the ear pinna. As indicated in the key there is only one pair of incisors in the upper jaw.

**Distribution and Status:** This bat is not well represented in museum collections though it seems to be fairly widespread in the Indus plains. Specimens have been collected from Kashmir and Mirpur, both in Jacobabad District, Naundero in Larkhana District and Sukkur, also at Nathan Shah in Dadu District, all regions in northern Sind. It has been collected from Muzaffargarh in the south west Punjab and Kalian in Sialkot District in the north east of the Punjab.



*Nycticeius pallidus* ○ Known distribution  
▨ Probable range

### Distribution Map 30 Yellow Desert Bat.

These are all relatively arid open regions without much tree cover and it appears to be confined to a semi-desert habitat in sub-tropical latitudes at low elevations, avoiding mountains.

It has been collected roosting in roof crevices, inside old tombs and pump houses. It seems to be peculiarly local and restricted in its total known distribution. It has not been recorded from southern Sind nor from anywhere in India, nor Afghanistan or Iran. It was originally described from Lahore in 1876 by Dobson though no record is traceable of specimens having been collected from Lahore region in this century.

It may be more widespread in the Punjab than present records indicate but in the light of present knowledge it appears rather rare and local outside of northwestern Sind.

**Biology:** Its flight has been observed to be rather slow and often quite close to the ground.

In Muzaffargarh it was found to be gregarious in its diurnal roost and both sexes were together when collected in mid March (University of Maryland Expedition). Mirza (1970) observes that the young are born in the summer at which time the sexes live separately.

### Genus SCOTOPHILUS Leach, 1821

There are about six species in this Genus found from Africa through the Middle East, Indo-Pakistan subcontinent and south east Asia to Indonesia. All tend to be associated with human dwellings, and are swift flyers with dentition adapted to crushing larger insects.

Rather large robust bats for a Vespertilionid, with belly fur

markedly paler than dorsal fur. Tragus more slender and forward curving than *Serotines*. Only one pair of incisors (like *Nycticeus*) (see Fig. 26) in the upper jaw with four upper (maxillary) cheek teeth, the second upper pre-molar being much reduced in size unlike *Pipistrellus* or *Eptesicus*.

The skull has a posterior projection at the base of the brain case, which is shaped like a 'helmet' and is formed by the joining of the sagittal and lamboid crests.

#### Key to the Pakistan Species of SCOTOPHILUS

- (i) Medium size. Forearm 42–55mm (1.64–2.14in.). Belly fur buff or pinkish-brown, occasionally with scattering of red-tipped hairs.  
... *Scotophilus temminckii*
- (ii) Size large. Forearm over 56–60mm (2.2–2.3in.). Belly fur an oily yellow colour, dorsal fur olive-brown or reddish-brown.  
... *Scotophilus beathi*

#### SCOTOPHILUS KUHLE

*Scotophilus kuhli* Leach, 1821; Temminck's House Bat or Lesser Yellow Bat.

Synonym *Scotophilus temminckii* Horsfield, 1824

Synonym *Scotophilus wroughstoni* Thomas, 1897.

**Taxonomy:** According to recent reviews of *Scotophilus temminckii*, the South East Asian population should all be assigned to *S. kuhli* which has precedence over *Temminckii*. (Peterson, 1968 and Hill and Kitti Thonglongyila, 1972).

**Description:** The fur of this bat is relatively short, close and sleek. Dorsally it varies from reddish to olive-brown in Pakistan specimens with the ventrum sharply contrasting creamy white, with a scattering of dark reddish tipped hairs in the mid-belly region.

The ears are relatively small and rounded and the tragus is half-moon shaped being markedly convex on its posterior border and concave anteriorly. The tip is slender and forward pointing and extends half way up the ear. The upper part of the muzzle behind the eyes often has glandular swellings and the canines appear powerful.

It can be separated from *S. beathi* by its smaller size (forearm always less than 56mm (2.18in.) and generally averaging 45–55mm (1.75–2.19in.)). Four specimens from Karachi had the head and body length averaging 76mm (3in.) (64–87mm (2.5–3.39in.) variation), the tail averaging 52mm (2.05in.) (47–58mm (1.8–2.26in.) variation) with the hind foot 11mm (0.4in.) and the ear 17mm (0.68in.). Specimens from around Bombay average smaller than this.

**Distribution and Status:** This species probably prefers more mesic conditions and warmer winters than *S. beathi*, since it has only been recorded in extreme southern Sind around Karachi and Thatta. The rest of its world distribution is in the warmer moister tropical regions of south east Asia.

It appears difficult to find in its diurnal biotope as there are rather few specimens in any museum collections. During the mammal survey of the Bombay Natural History Society in Kathiawar it was found roosting in the crowns of Palmyra Palms (Bombay Natural History Society Report, 1913). In Karachi, Walton found it roosting in roof crevices (pers. comm., 1972) and Brosset (1962) found a colony roosting under a roof, near Bombay.

It has also been collected in the extreme north west of the



*Scotophilus kuhli* ○ Known occurrence (Synonym *S. temminckii*)

▨ Probable range

Distribution Map 31 Temminck's House Bat or Lesser Yellow Bat.

Punjab near Changa Manga (Mirza, 1970) though it must be rare in that region since the University of Maryland expedition trapping in the same forest only encountered *S. beathi*. It is sympatric with *S. beathi* even in southern Sind and much less common than the latter even where it occurs.

It is widespread in central and western India though nowhere plentiful (Brosset, 1962). In Malaysia it is the common bat in lowland towns and villages and replaces *S. beathi* (Medway, 1969). As indicated above it is widespread in Burma, Taiwan, Indonesia, Borneo and south east China.

In Pakistan it must be regarded as very restricted in distribution and rather uncommon.

**Biology:** It is evidently quite anthropophilic in its ecology, preferring to haunt towns and villages and to roost in roof crevices during the daytime. In Karachi it has been observed to form small colonies of three to six individuals.

Like its larger relative it does not emerge to hunt until dusk and it has a relatively strong direct type of flight, presumably covering a fairly extensive territory in its hunting.

A detailed study of this species in Mysore (South India) showed that females form extensive maternal breeding colonies of up to 300 individuals, (Gopalakrishna, 1949). Twins were found to be commonly produced in this study, with parturition in March and the gestation period was found to vary from about 105 to 115 days. Nothing is known about their breeding in Pakistan.

#### SCOTOPHILUS HEATHI

*Scotophilus beathi* Horsfield, 1831; Common Yellow-bellied Bat or Desert Scotophil or Greater Yellow Bat (see Illustration 14).

**Description:** One of the largest of the Vespertilionid Bats with the forearm often measuring up to 64mm (2.50in.). Average of six specimens from south west Punjab and Karachi



area was 83mm head and body length (range 72–92mm) with the tail 55mm (range 51–60mm), the hind foot 12mm (range 11–13mm) and the ear 16mm (range 14–17mm).

This robust bat has relatively small triangular shaped ears, and short sleek body fur. The dorsal fur is olive to grey brown and the belly fur, separated by a clear line from the back, varies from a striking canary yellow to an oily yellow. The tragus is long and conspicuous and like *S. temminckii* it tapers to a slim forward curving point, the posterior border being markedly convex. The muzzle tends to be sparsely haired with swollen glandular pads between the eyes and the nostrils.

There is a single incisor in the upper jaw and the canines are powerfully developed (see Fig. 26). The wings are relatively slim and narrow and its flight is consequently rather swift and direct.

**Distribution and Status:** Though not as numerically abundant as some of the *Pipistrellus* species, in favoured localities, this is certainly the most ubiquitous and familiar bat species in the Indus plains. It is decidedly anthrophilic being found in all the large towns and near every human habitation even in remote rural areas.

Characteristically they occupy crevices or cracks in buildings behind wooden wainscoting — under roof tiles, etc. or wherever they can be in bodily contact dorsally and ventrally.

They are absent from mountainous regions of higher elevations but are plentiful even in extensive desert regions throughout Sind, Punjab and the valleys of the North West Frontier Province. Elsewhere they have spread to Afghanistan around Jalalabad (Meyer-Oehme, 1965 and Gaisler, 1970), though probably only as a summer visitor. They have not been recorded in Iran or the USSR. In India it is common all over

the lowland areas and extends to Burma, south east China, Sikkim, Ceylon and parts of Thailand. Brosset (1962) states that it is not found in extensive forested areas.

Well adapted to arid semi-desert regions and evidently capable of crossing mountain ranges, it apparently is not tolerant of the prolonged winters of northern latitudes.

**Biology:** They are fairly tolerant of bright light in their diurnal biotope and seem to like intra-specific bodily contact. A roost of about seventeen individuals is located near my office in an overhanging verandah parapet which is exposed to indirect but bright light. Moreover though the total available area is about 3m in length they are invariably clustered in the middle in two rows one on top of the other. They do not emerge to hunt as early as *Pipistrellus* species, preferring the onset of dusk, and they frequently return to their diurnal roost to rest on the open wall surface after bouts of hunting.

Generally they hunt fairly high up — wheeling in circles and swooping over trees with fast and direct flight. The elytra of small beetles can often be seen adhering to the ventral surface of their interfemoral membranes and they evidently use this membrane as a receptacle for holding larger insect prey while in flight.

In Khanewal area where I have been able to observe small colonies of this bat for a number of years, they tend to occupy certain sites for three or four months and then desert that particular spot until the corresponding period in the next year. Their strong musky odour clings to favoured roosting sites and may, of course, attract other individuals to re-occupy such deserted roosting sites. The rut appears to be in March and April when individuals call excitedly as they rest on walls and sometimes at this season I have observed fighting which

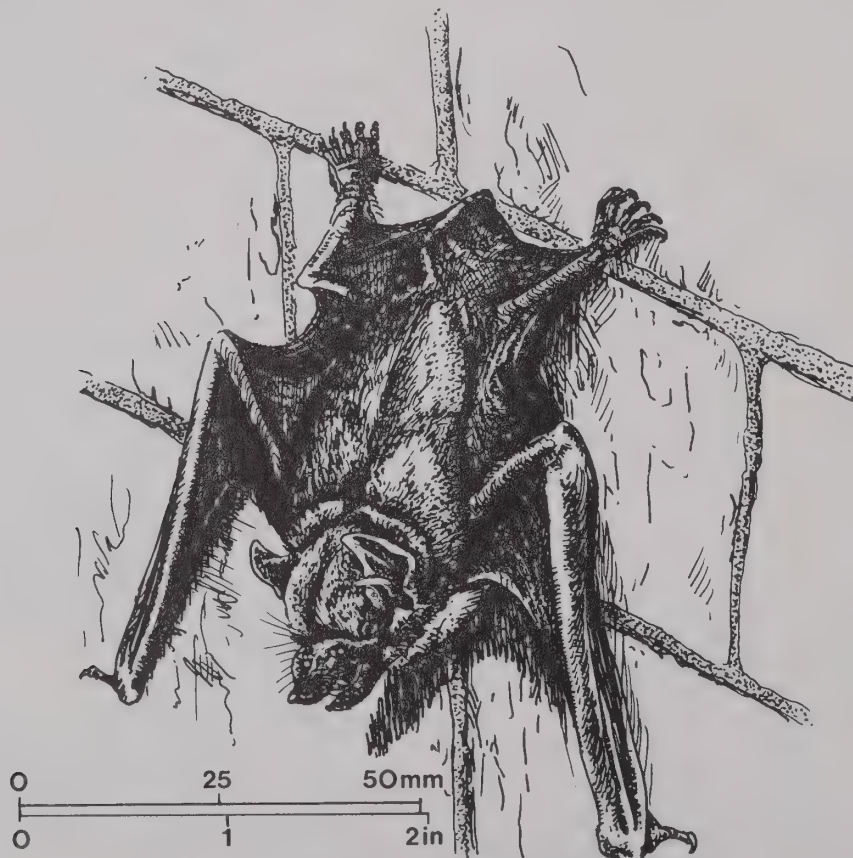


Illustration 14 *Scotophilus beathi*: Common Yellow-bellied Bat or Desert Scotophil or Greater Yellow Bat. (Based on live caught specimen adult male, Khanewal, Punjab.)



Scotophilus heathi

Distribution Map 32 Common Yellow-bellied Bat or Desert Scotophil or Greater Yellow Bat.

might be associated with sexual activity as they are normally quite gregarious. Specimens collected in late March in Jalalabad, Afghanistan were also sexually active at that season (Gaisler, 1970). They return to their diurnal roost within an hour or two of emerging in the evening and spend the greater part of the night resting with perhaps two more periods of about one hour each, hunting. Their strong dentition and swift flight enables them to tackle moths, larger diptera, coleoptera as well as smaller softer insects. They generally swoop over some open piece of water to drink when they first emerge as do the *Pipistrellus* species.

There is no prolonged hibernation but individuals undergo periods of torpidity or even hibernation during the winter months when they remain throughout the day in their diurnal roost. Certain individuals can however be seen hunting all months of the year even in the northern parts of the Punjab.

Brosset (1962) observed that this bat enters a state of diurnal hibernation during the day at certain seasons in that they refused to fly away when disturbed. He also observed that generally three or four individuals hunt together in the same territory and considered such territories to be restricted to the immediate vicinity of the diurnal roost (Brosset, 1962).

Parturition in central India is timed for the onset of the monsoon, most young being born from mid June to early August (Brosset, op. cit.). Prakash (1960) found this species in Rajasthan with two week old young in late August. Often the females produce two young (Brosset, op. cit.). In Khanewal I captured an independent young of this species on 5 April which was about one-third adult size though capable of strong flight. It was presumably four to six weeks old. The gestation period is probably like that of *S. temminckii*, of about  $3\frac{1}{2}$  months duration. During the Bombay Natural History Society's Survey of Gujarat and Palanpur in India, females of this species were observed in May returning to their diurnal roost to suckle their young which are apparently left behind quite soon after birth (Crump, 1914).

In the wild they are believed to have a life span of about three years (Walker et al., 1964).

#### Genus OTONYCTERIS Peters, 1859

This is a monotypic genus which is poorly represented in museum collections due to its restricted distribution and comparative rarity.

A large Vespertilionid Bat with tail shorter than head and body length and broad oval ears two-thirds the length of forearm. Body fur short, fluffy and of a distinctive pale greyish-brown tone.

Only one incisor in the upper jaw which is uni-cuspid and has a prominent cingulum.

#### Key to the Pakistan Species of OTONYCTERIS

- (i) Forearm 57–66mm (2.22–2.57in.). Ears average 38mm (1.5in.) long and when pressed together extend well beyond tip of snout. Tail averages 58mm (2.27in.) with head and body averaging 76mm (3in.).

... *Otonycteris hemprichi*

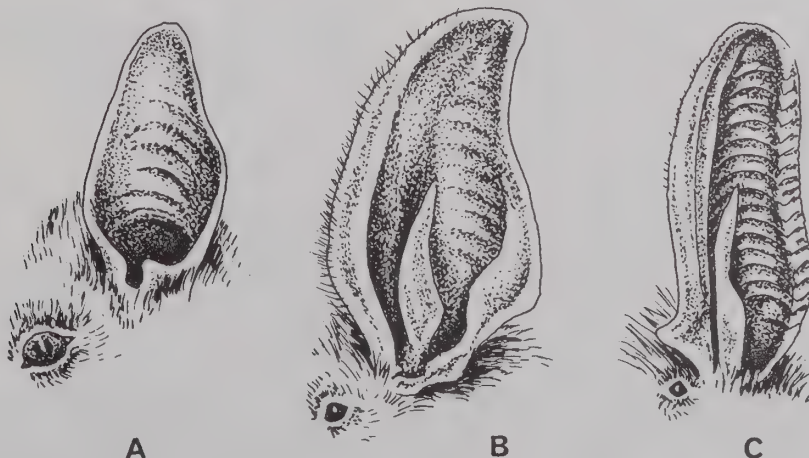


Fig. 27 Showing differences between various bats' ears.

A. *Rousettus leschenaulti*. A typical Megachiropteran without tragus and ear margin forming a complete tube.

B. *Otonycteris hemprichi*. With elongated tragus.

C. *Plecotus austriacus*. Note prominent notch at base of anterior margin of ear.



## OTONYCTERIS HEMPRICHI

*Otonycteris hemprichi* Peters, 1859; Hemprich's Long-eared Bat or Hemprich's Arrow-eared Bat.

**Description:** As indicated above, the colour of this bat is quite striking. The fur is very soft, the hairs long and fluffy and the ventrum is usually whitish whilst the dorsal fur is bluish-grey basally with brownish-white or sandy coloured tips. The fur around the neck and shoulders tends to be paler basally with an overall whitish tone.

It is a large Vespertilionid Bat with conspicuously long broad ears. The ears are a pale yellowish-grey colour, with a fold along the anterior margin fringed with hairs (see Fig. 27) and nine or ten transverse ridges inside the conch. In width the ears are about three-quarters of their total length at their median and widest part. The tips are bluntly rounded and there is no notch or projection at the base of the anterior margin as is found in *Plecotus* (long-eared) bats. The tragus is elongated and lanceolate but broader at its base and is usually 20mm (0.8in.) in length, which is roughly half the ear length.

The wings are relatively broad with the fifth digit longer than the fourth. The interfemoral membrane is supported by a short but strong calcar without any lobe and the tip of the tail extends beyond the interfemoral membrane for about 3–4mm (0.13–0.15in.). The flying membrane, though thick and leathery, is a remarkable translucent pale brown colour and there are indistinct radiating impunctations across the interfemoral membrane.

Eight specimens from Pakistan had the head and body averaging 76mm (range from 73–81mm) (2.83–3.21in.), with the tail averaging 58mm (range 55–61mm), hind foot averaging 15mm (0.58in.), ear averaging 38mm (range 37–40mm) (1.44–1.56in.) with the tragus varying from 19–20mm (0.75–0.77in.).

According to Walker (1964) a unique feature of this Bat is that the females often bear two pairs of pectoral mammae.

**Distribution and Status:** Evidently adapted to steppe mountain conditions or upland desert, this bat has only been recorded from northern Gilgit and it is quite plentiful in the Gupis Valley at 2360m (7750ft) elevation. It was also collected at 1600m (5300ft elevation) in Gilgit main valley in 1876 by Captain J. Biddulph.

Its total known distribution includes the Arabian peninsula, Egypt, Libya and Tunisia, Asiatic Russia from Turkestan to the Altai (Ellerman and Morrison-Scott, 1951 and Bobrinskii et al., 1965). There is only a single record from Khorassan in northern Iran (Etemad, 1969) and it is considered rare in the USSR (Bobrinskii, 1965), as well as in Arabia and Iraq (D. L. Harrison, 1964). There is a single record also for Afghanistan from near Kabul (Meyer-Oehme, 1965).

This rare bat is certainly one of the most interesting and least known species inhabiting Pakistan. It may possibly be found to occur in Baluchistan when more intensive collecting is possible in this region.

**Biology:** In Arabia two specimens of this bat were found on a steep hillside inhabiting a narrow crack behind a hanging stone (D. L. Harrison, 1964). There is no information as to its preference for its diurnal roost in Pakistan though Cheesman found it in buildings in Iraq (Cheesman, 1920).

Russian authors describe it as emerging to hunt only at dusk and flying with very characteristic slow regular wing beats reminiscent of a bird (Ognev, 1928). Its flight is not erratic and darting and it apparently hunts close to the ground.



Distribution Map 33 Hemprich's Long-eared Bat or Arrow-eared Bat.

Its broad wings would indicate ability to maintain very controlled flight enabling it to search close to the surface of low bushes and rocks.

A female was found bearing two foetuses in the Trans-Caspian region of Russia on 12 June (Ognev, 1928). Immature specimens have been collected in Arabia in May and June (Walker et al., 1964).

## Genus PLECOTUS Geoffroy, 1818

Small size. Forearm 38–43mm (1.5–1.73in.). Enormous ears equal to head and body length, two incisors in the upper jaw and three lower pre-molars as in *Barbastellus*. A conspicuous projection at the base of the anterior margin of the ear (see Fig. 27).

### Key to the Pakistan Species of PLECOTUS

- (i) Dorsal fur blackish-grey basally and isabelline brown tipped. Head and body length 40–50mm (1.6–1.97in.). Ear 39–41mm (1.52–1.6in.).  
... *Plecotus austriacus*

## PLECOTUS AUSTRIACUS

*Plecotus austriacus* Fischer, 1829; Grey Long-eared Bat (see Illustration 15).

Synonym *Plecotus puck* Barret-Hamilton, 1907

Synonym *Plecotus wardi* Thomas, 1911

**Taxonomy:** This has only been recognized as a distinct and separate species subsequent to the publication of Ellerman and Morrison-Scott's checklist (1951). There are only two species in the genus *Plecotus* and they are a classical example of sibling species, being difficult to separate even in the hand.

If a large series of both species can be compared, it will be found that *P. austriacus* averages slightly larger in size but has comparatively shorter thumbs (Pollex) and hind feet (Corbett, 1964). Moreover the dorsal fur basally is blackish-grey whilst

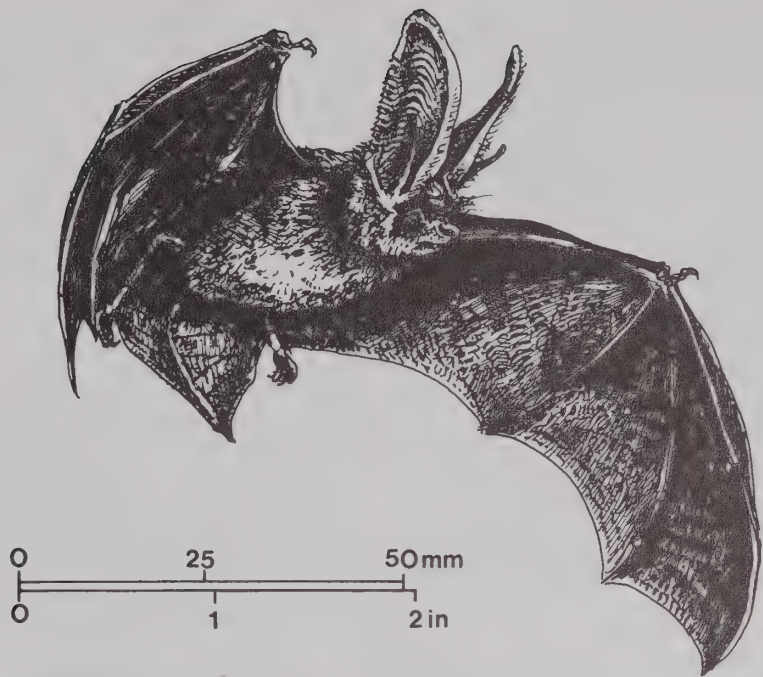


Illustration 15 *Plecotus austriacus*: Grey Long-eared Bat.  
(Based on study specimen, Smithsonian National Museum, USA, from Shogran, Hazara District.)

that of *P. auritus* is a dark chocolate brown in the proximal region. In both species the tips of the hairs are pale buffy brown. Finally the shape of the baculum (os penis) is markedly shorter and broader in *P. austriacus* with its proximal limbs short (see Fig. 28).  
There appear to be marked ecological differences also, *P.*

*austriacus* inhabiting warmer more southern Mediterranean regions in Europe than *P. auritus* which extends into northern Europe.

**Description:** A delicately built Vespertilionid with enormous ears roughly equal to the head and body length.

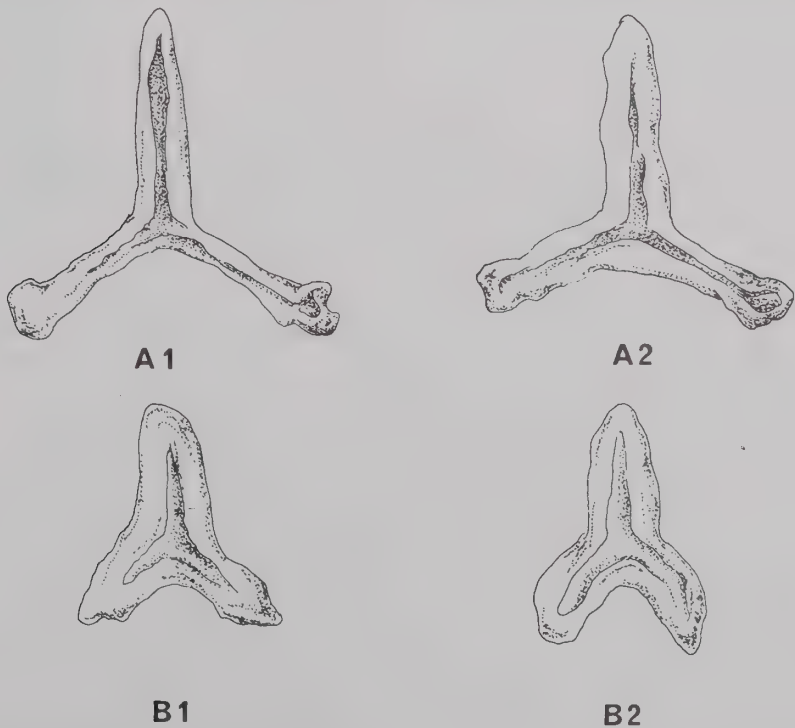


Fig. 28 Showing difference between *os penis* of *Plecotus auritus* and *Plecotus austriacus*.

A1 and A2. Two examples of *Plecotus auritus*. Note all three limbs of the Y are long and slender, being about three times as long as their width.

B1 and B2. Two examples from *Plecotus austriacus*. Note the limbs of the Y are broad and short, particularly the paired or proximal limbs.



The body fur is relatively long and thick and tipped pale straw or buff-brown with the basal part blackish. The belly fur is white with the base of the hairs dusky grey. The wings are comparatively broad and short. The fifth digit exceeds in length the forearm. The tail is long, slightly longer than the head and body length and the interfemoral membrane encloses the whole tail, being supported by a rather long thin calcar. There is no lobe and the flight membranes are brownish.

The ear conch is an elongated oval, bluntly rounded and curling slightly upwards or backwards at the tip. Inside the conch there are about twenty transverse ridges and the tragus is long and lanceolate measuring up to 20mm (0.75in.) and half the height of the ear. The pinnae are brownish and semi-translucent and fringed with hairs along both anterior and posterior margins as also the peculiar rounded projections at the base of the ear on the anterior margin (see Fig. 27). These projections almost meet across the forehead.

A series of eleven specimens from Pakistan had the forearm averaging 43.8mm (1.73in.), the head and body length averaging 48mm (1.87in.), the tail 50.2mm (1.98in.) average and the hind foot 8.8mm (0.34in.) with the ear averaging 40mm (1.6in.) and the tragus 18mm (0.70in.).

**Distribution and Status:** This bat in Europe is associated with deciduous woodland, but in Pakistan it has been found in Himalayan moist temperate forest (mixed deciduous and coniferous) and in more arid regions further north with tree plantations around the valleys and river banks. It is only found in mountainous regions in fairly cool temperate zones in Pakistan.

It has been collected in the Murree Hills (Wroughton, 1918) and more recently by the University of Maryland expedition in Shogran in Hazara District, and by the author at 8200ft in Sharan, also in Hazara District. All these localities are above 2380m (7800ft) elevation in thick forest. It has also been collected in Gilgit town near groves of Chinar trees (*Platanus orientalis*) at 1450m (4770ft) and at Rattoo in Astor District of Gilgit.

It has also been collected in Ladakh and the eastern part of Indian Kashmir. Apparently this species is not very social in its diurnal roost in the summer, and they are not very plentiful even in the regions of Pakistan where they have been collected.

Its world distribution is probably most of southern Europe, and southern Russia from the Ukraine, Caucasus, Trans-Caucasia across to Russian Turkestan (Bobrinskii et al., 1965). In Iran there are a few scattered records mainly in the north east (Etemad, 1969) and from Afghanistan around Kabul and Bamian (Gaisler, 1970).

**Biology:** This bat has been found roosting in mine tunnels, and roofs of houses (Harrison, 1964 and Gaisler, 1970) and presumably in Pakistan also inhabits mainly buildings or natural rock caverns. It seems to require a fairly dark place for its roost and often occurs in quite small colonies. I found a colony of about 40 individuals in a roof loft hanging in the open from a wooden beam, but in a tight packed cluster. Upon disturbance they retreated into crevices of the stone walls. Characteristically when at rest they have their long ears tucked under their forearms with only the tragus extended and this attitude is invariably adopted when hibernating (see Fig. 29). They hang freely by their hind feet in their diurnal roost.



Fig. 29 Showing typical roosting posture of *Plecotus austriacus* with tragi pointing downwards, whilst ears are folded under the wings.



Distribution Map 34 Grey Long-eared Bat.

They emerge to hunt after dusk and as might be expected from their wing shape their flight is comparatively slow and controlled. They are capable of hovering in front of objects such as leaves and twigs and their hunting territory is around the surface of trees and bushes being similar to that of the *Rhinolophidae* (Horseshoe) Bats. They are thus capable of searching the surface of leaves and branches to pick off insects as they hover. Their small size and relatively weak dentition indicates that they probably feed mainly on smaller moths, spiders and lacewings, (*Planipennia* sp.).

The closely related *P. auritus*, forms separate maternal colonies in the summer and it seems probable that *P. austriacus* also has the same habit. In the colony seen by me, out of seven individuals caught at random, six were females and one a sub-adult male. A female collected in Arabia was pregnant in early

March (D. L. Harrison, 1964) and probably the Pakistan population also breeds in the spring or early summer.

In winter it regularly undergoes hibernation and seeks more sheltered localities deep in caves or the loft area of buildings with pitched roofs.

**Genus MINIOPTERUS** Bonaparte, 1837

### MINIOPTERUS SCHREIBERSI

*Miniopterus schreibersi* Kuhl, 1819; Long-winged Bat, or Schreiber's Bat.

**Description:** This species has not been recorded anywhere in Pakistan territory as yet. Bats of the Genus *Miniopterus* are often called 'bent-winged bats', having the unique feature not shared by any other Vespertilionidae, in that the third finger or digit is bent backwards when the bats are at rest, the second phalange of this third digit being nearly three times the length of the first or proximal phalange (see Fig. 18).

They are also characterized by having relatively small rounded ears set wide apart, long dense fur and comparatively long tails wholly enclosed in the interfemoral membrane.

**Distribution and Status:** *Miniopterus schreibersi* occurs in eastern central Afghanistan around Jalalabad (Gaisler, 1970) and throughout northern Iran (Etemad, 1970), as well as in the Himalayas from Kumaon to Nepal and other mountainous regions of peninsular India (Ellerman and Morrison-Scott, 1951). It spreads across Russia from Trans-Caspia to Tadzhikistan (Bobrinskii et al., 1965). It has not been recorded anywhere in Pakistan but several authorities assert that it is likely to occur in Pakistan territory (Niethammer, in lit., Gaisler, 1970) since it is apparently quite adapted to live in fairly arid mountainous regions. Since it is a very widespread species, ranging from Australia to France in the Mediterranean region it is rather surprising that it has not been found in Pakistan. However Brosset's studies (1962, Part III) indicate that this highly colonial species requires rather special conditions for its main colony roost or biotope. A large natural cavern with a subterranean river and high humidity is characteristic of the colonies found in India, Africa and France. Perhaps such a suitable biotope is not available anywhere in Pakistan.

### SUBFAMILY MURININAE — TUBE-NOSED BATS

**Genus MURINA** Gray, 1842

Nostrils prominent and tubular extending beyond the upper lip in two bifurcating tubes (see Fig. 30). Two pairs of upper incisors and two upper pre-molars, P.M.(1) being reduced in size.

The Genus *Murina* comprises about ten species and is widespread in south east Asia extending into Taiwan, Japan and Asiatic Russia. All are small bats with rather soft woolly fur and broad wings.

### Key to the Pakistan Species of MURINA

- (i) Forearm length 32–36mm (1.25–1.4in.). Uropatagium lightly covered with hairs throughout dorsal surface. Tragus very slender and pointed. Dorsal fur greyish-brown.

... *Murina huttoni*



Fig. 30 Showing characteristic appearance of Tube-nosed Bats.

1. Side view of head of *Murina huttoni*. Note long slender tragus.

2. Ventral view of *Murina huttoni*.

### MURINA HUTTONI

*Murina huttoni* Peters, 1872; Peters' Tube-nosed Bat.

Synonym *Harpiocephalus tubinarius* Scully, 1881.

**Description:** A small bat which has rather long and wavy body fur. The dorsal hairs have silvery-grey tips and the belly fur is greyish-brown. The hairs both dorsally and ventrally are leaden-grey basally. The interfemoral membrane, which wholly encloses the tail, shows closely parallel and radiating lines of darker impunctations. There is a strong calcar without any lobe. The thumb is conspicuously long in this species and the fifth digit is relatively long giving the wing a broad outline. The ears are widely spaced, relatively small and oval in outline with the tragus long, slender and pointed and extending about two-thirds of the height of the pinna. As indicated above, the most noticeable feature of this bat is in the shape of the nostrils located on two short bifurcating tubes. In Pakistan specimens the dorsal surface of the interfemoral membrane is covered all over with silvery-grey hairs as also the rear margin of the membrane which is hair fringed (see Fig. 19).

Two specimens from Pakistan had the head and body



Distribution Map 35 Peters' Tube-nosed Bat.



length 43–53mm (1.67–2.07in.) respectively, the tail 22mm (0.88in.) and 35mm (1.37in.). Hind foot averaging 8.5mm (0.3in.) and the ear 14mm (0.6in.) with the forearm 32mm (1.26in.).

**Distribution and Status:** It is not well represented in museum collections and appears to be rather rare. It is not apparently highly colonial in its diurnal roost and individuals probably roost singly in tree cavities, under bark crevices as well as inside buildings in winter.

A specimen was collected from Gilgit in the Naltar Valley at 2150m (7000ft) and another (by the author) on the slopes of Miranjani in the Murree Hills at 2450m (8000ft). This latter specimen was found under a flake of bark. This bat is undoubtedly associated with mountainous country in temperate zones and it probably prefers forested regions (Naltar Valley has spruce forest).

Ognev (1928) noted that *M. buttoni* could not be clearly separated from *M. leucogaster* in the Russian population,

purely on the basis of size and the exact specific status of the asiatic forms of this Genus are still not well known.

In Pakistan *M. buttoni* is certainly uncommon and apparently has not extended to Hazara District, Swat or Chitral.

It has not been recorded in Afghanistan or the USSR (assuming it is a distinct species from *M. leucogaster*). Elsewhere it spreads to Burma, Indo-China and parts of China.

**Biology:** Nothing seems to have been recorded about this species and indeed regarding the breeding biology of the whole Genus (Walker et al., 1964). *Murina aurata* from Japan has been found to breed in late May and early June producing one to two young in a tree cavity, often using deserted woodpecker holes (Imaizumi, 1970).

Presumably they have a rather slow and controlled flight. They have been described as flying close to the ground when hunting (Walker et al., 1964). The species definitely hibernates in winter. It is not known whether the tubular nostrils have any ecological significance.

## 6 PRIMATES

Of special interest to mankind, this Order includes not only the relatively primitive Lemurs, Lorises, Pottos and Bush Babies but also the higher Apes and Man, who has been assigned to the Genus *Homo*.

Most Primates have developed binocular vision and sight is the primary faculty in hunting with the sense of smell and hearing secondary. With the exception of man, Primates have the thumb of the hind-foot opposable which enables them to grip branches and the Order as a whole is adapted to an arboreal existence. The most unique feature however is the great development of the cerebral hemispheres of the brain, which of course, reach their largest size in man (see Fig. 31). The Order includes 193 species, only two of which occur in Pakistan and both belong to the family Cercopithecidae.

### FAMILY CERCOPITHECIDAE – BABOONS, MANGABEYS, GUENONS, MACAQUES RHESUS MONKEYS AND LANGURS

#### Key to the Pakistan Species

Skin around eyes, nose and mouth livid pink colour. Body fur olive-brown and tail less than head and body length.

... *Macaca mulatta* – Rhesus Macaque.

Skin around eyes, nose and mouth black, body fur silvery-grey with tail much longer than head and body.

... *Presbytis entellus* – Grey Langur.

#### MACACA MULATTA

*Macaca mulatta* Zimmermann, 1780; Rhesus Macaque (see Illustration 16).

Subspecies *Macaca mulatta villosa* True, 1894; Himalayan Rhesus  
and *Macaca mulatta mcmahoni* Pocock, 1932; Giant Rhesus.

**Description:** The Rhesus Macaque is a relatively thickset, stocky monkey with a comparatively short tail.

Adult males from the Himalayas weigh between 7.25–10.9kg (16–24lb) with females of 5.47–6.8kg (12–15lb). The hind foot is quite broad being less elongated than that of the Langur monkey. It measures 14–15 cm ( $5\frac{1}{2}$ – $5\frac{7}{8}$  in.) The tail averages about 20.3cm (8in.) in length. The palms and soles are naked and pinkish-grey in colour and all digits end in round blunted nails not claws. The dorsal surface of hands and feet are thickly covered with pale silvery-brown hairs. The tail is thickly furred throughout, of an olive brown colour without any terminal tuft. The usual tail carriage when

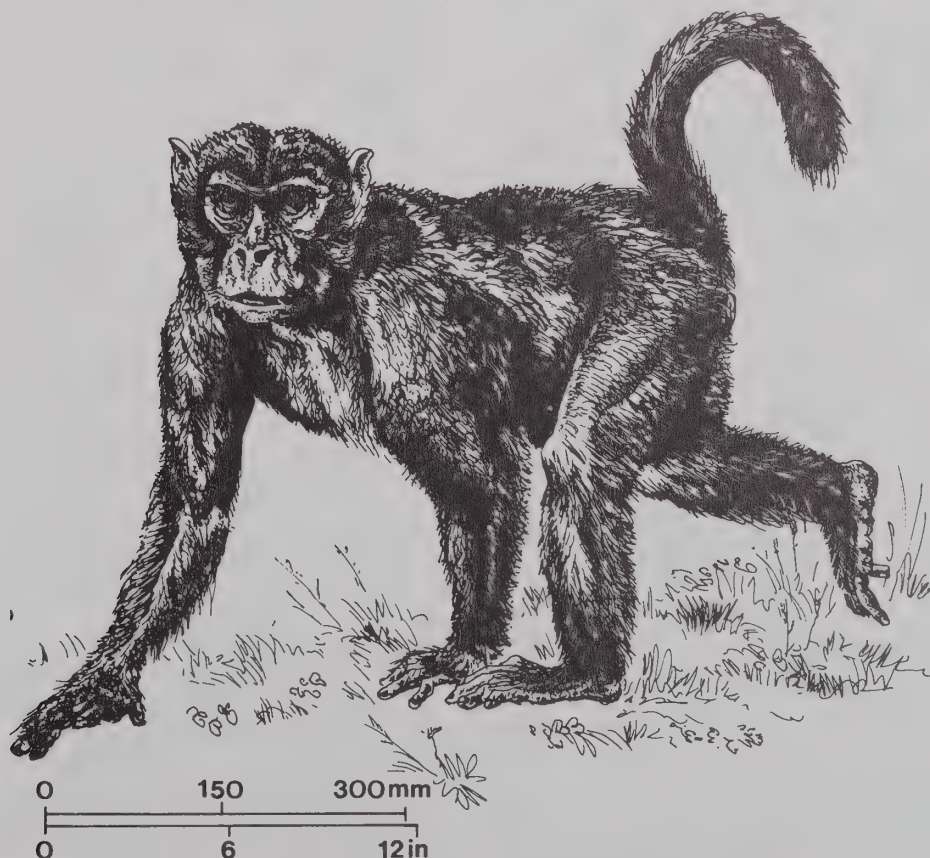


Illustration 16 *Macaca mulatta*: Himalayan Rhesus Monkey.  
(Based on sketches from wild monkeys, Dunga Gali,  
Murree Hills.)



walking on the ground, is vertically upwards with the distal half curling over backwards to form a  $360^\circ$  arc.

The general body colour is dark olive brown with paler silvery buff tinges around the cheeks, inside the limbs and on the belly. In Pakistan the body fur is very thick and luxuriant in winter with a thick bluish-grey under-fur and the most distinctive feature of this species is the ginger or rusty orange colouring of the fur covering the hind quarters and the outer hind limbs. The face including an area around the eyes and the broad deep muzzle is sparsely haired revealing naked livid pink skin. The eyes are deepset beneath a prominent supra-orbital ridge. The iris is hazel-brown in colour. The cheeks bear deep vertical folds and wrinkles and can be expanded to form extensive food pouches. In winter coat the semi-naked skin of the face is framed by a long ruff of hairs radiating outwards down either side of the cheeks. The naked ears are pinkish-grey and measure about 20mm ( $\frac{3}{4}$  in.) across in adults but in winter they are more or less concealed in the body fur.

Females have a conspicuous naked red callous in the caudal region which becomes turgescient and a livid red colour when the animal is in oestrus. There are two elongated pectoral teats which are generally clearly visible in the body fur of suckling females. Adult males become heavily muscular and develop prominent and elongated canine teeth (see Fig. 31). Even sub-adult males can be distinguished in the field by the greater length of their canines compared to those of adult females.

Juveniles lack the rusty tinge to the body fur over the hind quarters and are a slightly greyer brown in colour. The summer coat is thinner and lacks under-wool but still consists

of much longer hair than specimens which inhabit the plains of India. The subspecies inhabiting northern Pakistan are larger than those of other parts of the sub-continent.

**Distribution and Status:** In Pakistan this monkey is confined to mountainous regions having forest cover and it is typically associated with Himalayan moist temperate forest (see Chapter 2). It extends in the north west from the Kafir Valleys of the southern Chitral, southwards through Dir and eastwards through Swat Kohistan and Hazara District. The very large subspecies *M. mulatta mcmaboni* has been recorded around Kanti, Utzun and Shishi Koh in Chitral



*Macaca mulatta villosa*

Distribution Map 36 Himalayan Rhesus.

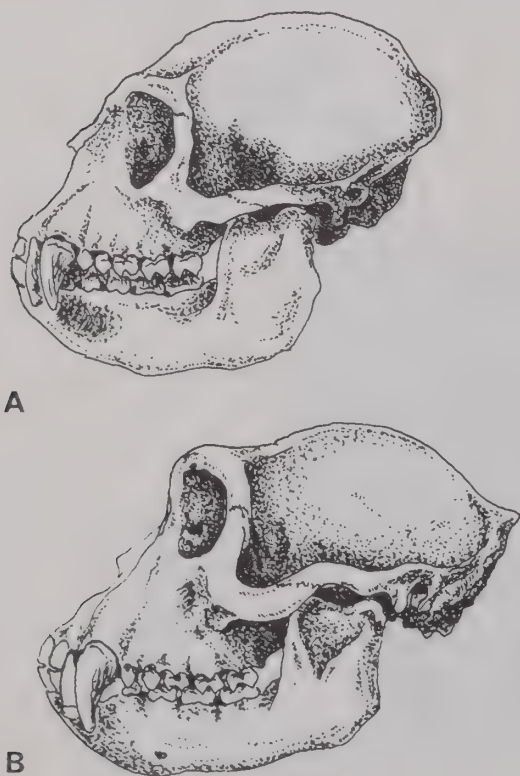


Fig. 31 Showing lateral view of skulls of monkey species.

- A. *Presbytis entellus*. Adult male. Note relatively shorter canine and less pronounced temporal ridges.
- B. *Macaca mulatta*. Adult male. Note powerful canine teeth and strongly developed temporal ridges.

(Fulton, 1903, & *Pakistan Wildlife Inquiry Commission Report*, 1969). These are dry regions with deodar forest (*Cedrus deodara*) and Chilgoza pine forest (*Pinus gerardiana*), and *Quercus ilex* on the lower slopes. In northern Dir it has been observed in the Landrai and Gwaldri valleys and also at Dokdusra. The subspecies *M. mulatta villosa* occurs in the lower Kaghan Valley around Paras and Shogran and also in the Neelum Valley of Azad Kashmir. The same race occurs throughout the Murree Hills. Individuals of the tiny surviving population in the outer foothills such as the Margalla Hills appear to be much smaller in size.

Although it is still much more widespread than the Langur, the Rhesus monkey has become quite rare both in Chitral and Swat Kohistan due to persecution by local villagers. With the opening up of new regions of Swat Kohistan and Hazara District for forest timber extraction the Rhesus population must inevitably decline further though their status seems fairly secure at the present time and despite shooting and trapping by local villagers they have demonstrated an ability to coexist even in heavily settled hill regions such as the Murree Hills. Because of their fondness for ripening maize cobs, local villagers lose no opportunity to destroy them. Young monkeys secured after the mother has been shot are always readily saleable as pets to visitors from the plains in the summer.

**Biology:** Monkeys have always been an object of intense interest and study by Man and the science of ethology had its first development in studies of the behaviour of Primates. A good deal has therefore been recorded about the habits and behaviour of the Rhesus Macaque (Koford, 1960, Southwick and Beg, 1961A, 1961B, 1961C).

The Rhesus monkey is gregarious in habits, living in troops or bands consisting of a number of adult males and females with young of all ages. In the lower foothills (e.g. in the Margalla Hills) these troops may consist of 12–20 individuals whilst in Himalayan moist temperate forest the troops are much larger generally consisting of 30–50 individuals. One troop observed around Dunga Gali throughout the summer of 1966 comprised about 75–80 individuals. These troops are larger than those usually observed in the Indian plains.

Occasionally an adult male becomes evicted from a troop and will lead a solitary existence. One such adult male regularly frequented the north-eastern slopes of Nathia Gali in 1964. It was a large male and appeared perfectly healthy. One of the largest males is invariably dominant in these troops with all the other adult animals being ranked in order of dominance. The dominant male usually decides when the troop should move to fresh feeding grounds and I have observed in the Murree Hills that, if this individual gives a warning grunt of alarm, the whole troop becomes at once most alert.

Rhesus monkeys are diurnal in feeding activity and forage to a considerable extent on the ground. Studies in India (Southwick, 1961C) indicate that they usually move regularly along a rough circuit within a particular territory, feeding as they go and sleeping in a fresh place each night. In the Murree Hills I have observed that if they are undisturbed and food supplies are plentiful they will feed in the same area for several days in a row, returning at night to the same group of trees. In the spring and early summer they eat a lot of grass and forbes and have been observed greedily pulling up handfuls. In the early spring before new grass growth is available in the Murree Hills, they feed on the young shoots and leaf buds of Ash trees (*Fraxinus excelsior*) and Black Poplars (*Populus ciliata*). I have seen a whole troop clambering over the bare branches and pulling the outer twigs towards their mouths to bite off the newly sprouting young leaves. They eat all kinds of fruits when available and in the Murree Hills they gorge themselves on the ripe berries of the Viburnum (*Viburnum nervosum*) in late June and early July. Before this they can be seen plucking wild strawberries (*Fragaria vesca*) which are plentiful in the Murree Hills in June. Later in the Monsoon they seem to increase the amount of insects taken in their diet and bands may be seen assiduously turning over rocks and stones in search of insect larvae and crustaceans. In early April before deciduous trees are in leaf, an individual was seen eating the leaves of the Yew tree (*Taxus baccata*). Since this tree is evergreen it may be an important food source in the winter months and this observation is of particular interest in view of the fact that the leaves of the Yew tree are considered poisonous for deer, goats and pigs. There is no evidence that the Rhesus monkey feeds to any extent upon pine cones or on the young shoots of coniferous trees but in Swat Kohistan they have been observed feeding on the seeds of the Chilgosa pine (*Pinus gerardiana*).

They start ascending into trees for sleeping well before dusk approaches. At this time in the summer months the young monkeys have a high pitched rather plaintive wail which they frequently emit and this appears to be a sort of contact call rather than indicating any discomfort or anxiety. When feeding or travelling undisturbed, adults keep in con-

tact with each other by emitting a rather soft 'Hooh-hooh' call. When alarmed they give a rather guttural barking grunt and this call from any member of a troop is enough to put the others on the alert. Fights frequently erupt particularly amongst younger animals and these are accompanied by loud screeching and chattering. Often the noise from such fights rings out across the valley revealing the presence of animals long before they can be sighted. I have observed individuals feeding quite unconcernedly close by, whilst the most blood curdling shrieks and fierce fighting takes place between subordinate members of a troop. However, on one occasion when one of the dominant males in a large troop was challenged by another male, I observed that the entire group ceased feeding and became highly agitated and excited even though in this instance the fight between the two large males did not go beyond aggressive and challenging postures.

During periods of rest between active foraging I have observed that they retreat to inaccessible cliffs or ascend trees and that they spend a large part of the time on such occasions in mutual grooming. Individuals, especially younger males often yawn when approaching or approached by other members of the troop during such rest periods. This yawning exposes the prominent canine and is probably a mild form of threat display.

Compared with the Langur, Rhesus monkeys are much bolder and exhibit signs of overt aggression more readily. Some authors think that this is characteristic of ground feeding monkeys (Eimerl, 1966 & De Vore, 1966). In Pakistan however Rhesus monkeys show a flight reaction whenever they encounter human beings and the local hill people regularly drive them away from their crops by throwing stones as well as by shooting them. In the Margalla Hills, particularly, these monkeys are extremely wary of human beings and besides immediate flight, try to avoid being seen. This is in sharp contrast to the behaviour of the Rhesus monkey in most parts of India where they are regarded as sacred by the Hindus and are relatively fearless of humans.

There was an authentic case in 1964 of a large Rhesus monkey running up to a twelve year old boy and biting him on the finger after the boy had thrown stones at the troop. This was on the outskirts of Murree where human encounters are presumably very frequent even with these forest dwelling troops. (Priddy, C., pers. comm.) There is some evidence for believing that they deliberately throw stones at human intruders. Certainly, on one occasion while walking along a footpath below a steep slope on which monkeys were feeding I observed that some monkeys deliberately threw stones into the air and these rolled down the slope amongst myself and companions. MacKinnon (1971) observed similar behaviour in baboons and was of the opinion that this was definitely not accidental and that the throwing of stones was an overt aggressive action. When a feeding troop encounters a human, their first reaction is to stare intently at the intruder at the same time jerking their head upwards. This is believed to be a mild threat. Often however their first reaction on being surprised is to retreat and then to turn round and give the head bobbing gesture.

In Pakistan young are only born once a year in the spring and early summer. The gestation period is 168 days in this species (Southwick, 1961A). Females are mature at four years of age and males at six, though they may be sexually mature much younger (Koford, 1965). Prater states that in the western Himalayas mating takes place during August and September, with the young being born in April and May (Prater, 1965). I have invariably observed mothers carrying very small young presumably less than two or three weeks of



age, from late April up to late June and it would appear that most mating activity takes place in November and December in Pakistan. A captive female in Bahawalpur Zoo from the Murree Hills was observed to be in oestrus condition in the first week of December. In the Murree Hills the majority of babies are born in late April and early May. In one troop observed on 12 April in Dunga Gali all the adult females appeared heavily pregnant but there were no newly born young discernible. Newly born young cling to the mother's belly fur and even when very small they appear to be unaided when the mother moves around as she makes no attempt to support them. Observations by Koford (1965) indicate that the young remain emotionally attached to their mother for a full twelve months and in fact may still suckle the mother occasionally throughout this period until the next infant is born. After they are about one month old the young become more venturesome and will leave the mother when she comes to the ground to feed. However at this stage I have observed that the mother will pull the infant back if it ventures more than a few feet from her.

Wild monkeys probably live about 10–12 years though many captive specimens have lived over 15 years and one specimen survived 28 years (Crandall, 1964). In Pakistan leopards and man are their principal enemies and leopards are reputed to be particularly fond of monkeys as food. Wild monkeys can be frequently observed scratching themselves, though there is no evidence in Pakistan whether they are troubled by external parasites. Mutual grooming and self scratching may simply be a source of physical satisfaction.

Observations on a newly captured Rhesus monkey showed that they use their sense of smell as well as eye-sight to test

most foods before eating them and they seem willing to test a variety of unknown food substances, an important attribute in an animal which is largely omnivorous in diet. The same young monkey always stuffed any proffered food entirely into its mouth even though it was not disturbed and could have fed leisurely. This seems to be the normal method of feeding with the cheek pouches being used for temporary storage. The monkey then retreats to a safe area and swallows the food in spaced mouthfuls by transferring boluses with its tongue from its cheek pouch, if the food is pulpy. When the food is fibrous it does this by inserting the finger into the mouth to bring a quantity forward for mastication.

### PRESBYTIS ENTELLUS

*Presbytis entellus* Dufresne, 1797; Grey Langur.

Subspecies *Presbytis entellus ajax* Pocock, 1928; Kashmir Grey Langur (see Illustration 17).

**Description:** The Himalayan Langur is quite a large sized monkey (considerably taller when sitting, than the Rhesus) but it is a graceful and beautiful animal, terms which one would hardly apply when describing the Himalayan Rhesus Monkey. Their bodies are lithe and lean with deep chests and very long legs giving them an almost greyhound appearance when they are on the ground.

Male specimens of this sub-species weigh up to 20.9kg (46lb) with females weighing 12.7kg (28lb) (Pocock, 1939). The head and body of adult males is about 76.2cm (30in.) in length with the tail 86.4cm (34in.) long, whilst females measure about 63.5cm (25in.) head and body with the tail

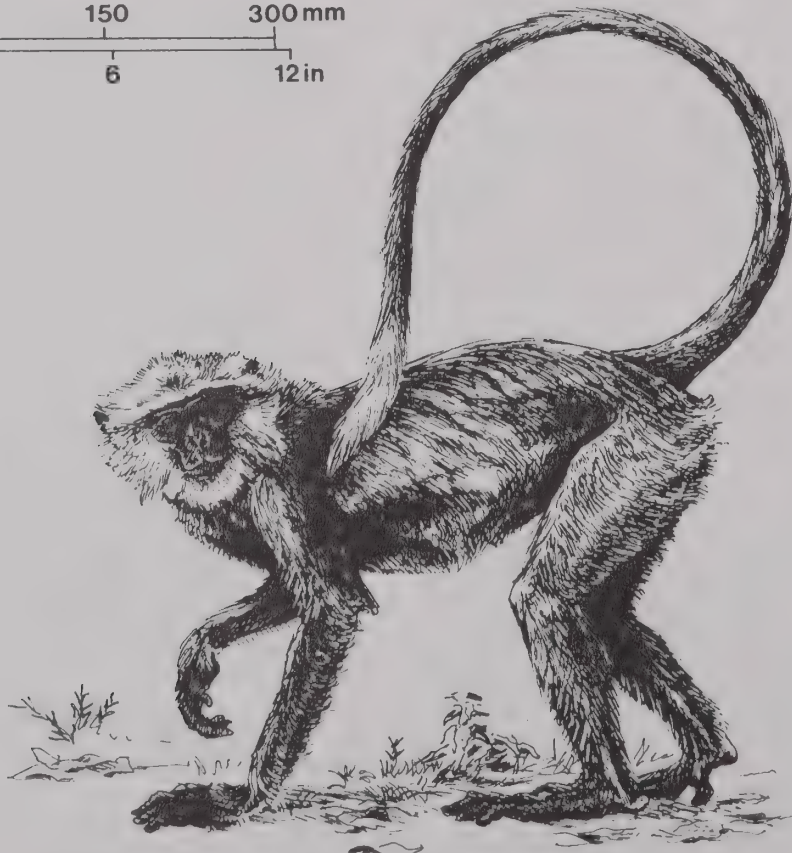
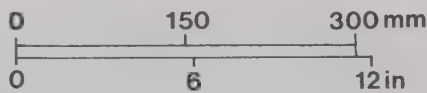


Illustration 17 *Presbytis entellus*: Kashmir Grey Langur.  
(Based on photographs kindly loaned by Zahid Beg  
Mirza of adult female, Shogran, Hazara District.)

about 78.8cm (31in.) long. The hind foot is comparatively longer and more slender than that of the Rhesus Macaque measuring 21.6–22.9cm (8½–9in.) in adults.

The naked skin around the eyes, cheeks and muzzle is purplish-black in colour and framed by a ruff of radiating creamy-white hairs giving the face a very striking appearance when viewed from in front. The naked black ears are concealed by this facial ruff. The very long tail is clothed with short brownish-grey hairs. The tip has creamy-white longer hairs forming a slight terminal tuft. The rest of the body is a brownish-grey and the belly fur is whitish. In winter coat the hairs on the shoulders and back attain a very considerable length in adult specimens, almost forming a mane over the shoulders.

The subspecies *P. entellus ajax* is mainly distinguished by its larger size when compared with subspecies inhabiting lower altitudes and warmer regions further to the east. Also the outer side of both fore and hind limbs is covered with silvery-black hairs so that from a distance the limbs look quite black. With its long legs, this monkey can run over the ground very swiftly and a band of these creatures when encountered in the forest is a striking and beautiful sight. The long tail is always carried curved in a broad arc over their backs when they are on the ground. Studies of the south Indian population of the Langur, however reveal a different tail carriage – curved away from the hind quarters as in the Rhesus (Jay, 1965).

**Distribution and Status:** The Langur Monkey is ecologically very adaptable and in parts of the subcontinent can be found thriving in quite dry savannah country as well as in the tropical rain forest. In Pakistan, and other parts of the Himalayas, however, it lives in coniferous forest. In summer it ascends to the limit of the tree-line at 3050m (10,000ft) whilst even in winter when snow is on the ground it rarely descends below 2150m (7000ft) elevation.

Within this habitat the Grey Langur is so limited in its range within Pakistan that its occurrence is not generally known. It has been observed in three localities in Hazara District. On the south east face of the Kunhar Valley around

Shogran, in Dhanial forests, and around Sharan west of the Kunhar River. It also occurs in Azad Kashmir in the Jhelum Valley at Mundkro Forest. There are also unconfirmed reports of the existence of Grey Langurs on the higher mountain slopes in the north of Amb State. This area is comparatively poor in forest and it is unlikely that Langurs have been able to push this far west.

Though Langurs do not raid crops like the Rhesus Macaques in the same region, they are very restricted in numbers largely because living conditions for such a leaf-eating species, are very harsh in the long winter months at these latitudes. This beautiful monkey must be considered extremely rare within Pakistan territory, and excluding Azad Kashmir the total population is probably much less than two hundred.

**Biology:** The Himalayan Langur Monkey is a skyer animal than the Rhesus Macaque, and spends much more time feeding in trees, descending to the ground only occasionally. Their copious, sacculated stomachs, enable them to deal with a bulky fibrous diet consisting at times only of mature tree leaves, upon which the Rhesus Macaque could not subsist. Studies of the Langur in south India indicate that they live in fairly stable bands which constantly keep together and do not join up even temporarily with other Langur bands (Jay, 1965). In some of the dryer areas of the plains such groups may number less than twenty individuals, but in Pakistan they appear to remain in fairly large troops numbering forty to sixty individuals. These bands are led by the males and they migrate over considerable territory in their day to day foraging.

Langurs are diurnal in activity, and in the spring and summer months confine most of their feeding to the early morning and late afternoon. In the winter, especially in the higher hill regions where they are less disturbed at this season of the year, they generally continue feeding throughout the day. In summer in the Shogran Forest area of Hazara District, they have been observed to eat all types of deciduous tree leaves especially the Himalayan Horse Chestnut (*Aesculus indica*) and the Maple (*Acer caesium*). They will feed greedily upon the young leaf buds and shoots and any flowering tree. They also descend to the ground in June to eat wild fruits of the raspberry (*Rubus purpureus*) and ill-scented Viburnum (*Viburnum nervosum*). It appears that they are exclusively herbivorous and have not been observed turning over stones on the ground to hunt for insects and crustacea as do the Rhesus Monkeys. It is probable that during severe winters they eat the immature cones of the Blue Pine (*Pinus wallichiana*), as well as the leaves of the Yew tree (*Taxus baccata*). Observations in semi-arid regions of south India revealed that individual bands can survive for several months on end, without drinking any free water (Jay, op. cit.). In Pakistan they live in areas where springs are plentiful and probably do drink water as needed.

In many parts of India where the Langurs are never molested, they become very bold and small bands of a dozen or fewer live in scattered groups alongside the roads. In Pakistan they are very wary of humans and keep a constant look out for danger, their hearing being as acutely developed as their eyesight. They have a barking alarm call when they are aware of approaching danger at which time the whole band quickly ascends into the trees and then makes off at tree-top level with great agility and prodigious leaps. Jay (1965) observed that when a Langur group was about to migrate or travel to a new feeding area the adult males, who were the leaders of the troop, gave a peculiar whooping call which she believed was intended to warn other Langur groups of



*Presbytis entellus ajax* ○



their whereabouts thereby avoiding a meeting. As with Rhesus troops, young Langurs frequently fight, and then emit loud squealing cries.

Males do not breed until they are about six or seven years of age, by which time their canines are fully erupted. Mature males prevent any of the males below this age from attempting to mate though they may be sexually mature. The female first comes into oestrus at about  $3\frac{1}{2}$  years of age. Contrary to the breeding habits of the Rhesus, with the males aggressively soliciting females, sexual activity seems comparatively limited in the Langur and males show no interest in the females until one of them is in oestrus condition. At this time it is solely the oestrus female who has a sort of initiating ceremony to attract the male (Jay, op. cit.). There is no conspicuous perineal swelling of the oestrus female as can be observed with the Rhesus Monkeys. Prater states that in peninsular India most of the young are born between January and March, but that in the Himalayan subspecies the young are born in May and June (Prater, 1965). In the Kaghan Valley females have been observed carrying very small young in March as well as in May and June, and presumably the breeding cycle is limited, so that young are not born later in the summer when young leaves with a higher protein content are no longer available in abundance.

Twins have not been recorded in this species, and it is probable that only a single young is born at a time because of the difficulty that the mother would experience in escaping from predators while carrying its young as it grows larger. Probably in the Himalayas the young suckle for eight to ten months but they may begin to show an interest in solid food when they are two months of age. The young Langurs are quite a dark brown colour, in contrast to the paler grey of

their parents. They do not lose this colour until they are between three and five months of age. A baby Langur clings to its mother's belly fur with all four limbs when she is travelling through the tree-tops and it is only whilst the baby is a few hours old that the mother supports it with one hand when she moves. After it is a few hours old it can cling on independently, even when the mother is leaping from branch to branch (Jay, 1962). Some authorities believe that the gestation period is about 196 days (Walker, 1964). Dr. Jay considered the gestation period to last not more six months (Jay, op. cit.).

Langurs are not aggressive amongst themselves and seem to live a relatively tranquil existence. Threatening gestures are stylized and they rarely resort to actual chasing of each other much less physical combat. As with the Rhesus monkey, staring hard is a mild threat gesture. This is then followed by biting the air, and if the Langur becomes further excited or annoyed it will slap the ground with its palms and finally charge forward towards the subject of its aggression, but without completing its attack. The Himalayan Langur, less accustomed to human disturbance and of larger size, may however be more aggressive. H. Khanjuria, encountering these Langurs in Kashmir claimed that they threw stones at human intruders (Khanjuria, 1955) but he does not seem to have made any detailed observations. I also recall in 1946 that a spaniel dog was attacked and bitten by a large male Langur in Gulmarg, Kashmir though this may have been an isolated incident. As Langurs are comparatively delicate there are no recent records of captive individuals having lived for longer than seven years. However there is a record of one individual having lived in the Chicago Zoological Park for 22 years (Crandall, 1964).

## 7 PHOLIDOTA

The word 'Pholidota' is derived from the Greek words meaning 'scaled animal'. All the species within this extraordinary order are Scaly Anteaters, and are placed within a single genus *Manis* in the family Manidae. There are seven species of *Manis*, four of which are confined to Africa and three of which occur in south east Asia. In all of them the upper part of the body is covered with overlapping scales composed of modified agglutinated hairs, and the head is long and narrow with no teeth. Unable to bite, and a passive attitude being their only defence, they can roll themselves into a ball with only the tough horny scales on the outside.

### FAMILY MANIDAE – SCALY ANTEATERS

#### Key to the Pakistan Species

Back covered with overlapping horny scales (Khaki coloured).  
Tip of tail without any naked glandular area (as in *Manis pentadactyla* which occurs in Bangla Desh)

... *Manis crassicaudata*

#### MANIS CRASSICAUDATA

*Manis crassicaudata* Gray, 1827; Indian Pangolin or Scaly Anteater (see Illustration 18).

**Description:** The Indian Pangolin has a relatively tiny head, a hump-backed body and a thick tapering tail almost equal in length to its body. The top of the head, the whole of the upper neck, trunk and outside of the limbs are covered with overlapping bluntly pointed horny scales. Both dorsal and ventral surfaces of the tail are also armoured with scales. These are a dirty yellowish colour or olive khaki and the animal looks for all the world like a 'perambulating artichoke'. The scales bear fine longitudinal striations of their surface (see Fig. 32). They are quite sharp on their outer edge and there are scattered reddish bristles interspersed between the scales. The two mammae in the female are situated pectorally.

There is hardly any external ear and the muzzle tapers to a narrow down-curving trunklike snout. The external ear pinna consists merely of a shallow crescent shaped vertical fold in the naked skin, and is covered all over with short bristles. The mouth is set underneath the muzzle. It is very small and the jaws cannot open very far. The tongue is cylindrical, long and narrow and can protrude 25.25 cm (10 in.) beyond the tip of the snout and is about 5 mm ( $\frac{3}{16}$  in.) broad. A sub-adult female had a tongue exactly 23 cm (9 in.) long, from its tip to the end of the lower jaw, when it was fully extended. The lower part of the face, throat, inside of all four legs and belly is covered with soft naked pinkish-white skin which has a sparse covering of reddish blond hairs.

The hind legs are stout and rather columnar with five blunt pinkish-white toe nails resembling those on an elephant's foot. The circular sole of the hind foot is covered by a roughened spongy pad which is black, increasing its resemblance to an elephant's foot. The insides of the hind legs from the knee downwards are also covered with horny scales but the

insides of the forelimbs are not so protected. The forefeet are also shorter and bear five digits, the three middle ones terminating in enormously powerful elongated claws. The third digit bears a claw measuring up to 50 mm (2 in.) and the second and fourth digits have claws about 40 mm ( $1\frac{5}{8}$  in.) in length. The Pangolin walks on the knuckles of its forefeet with these huge claws bent backwards and pointing clear of the ground. The palm of the forefeet is soft and not calloused like that of the hind foot.

In the sub-adult female specimen referred to above, which was collected near Sialkot, there were five parallel rows of scales running longitudinally down the surface of the tail, and the body had eleven parallel rows of scales over the shoulders which increased to thirteen rows in the hinder part of the body. The scales over the head and neck are much smaller than the dorsal-scales. The tail is rounded on the dorsal surface and flattened on the ventral surface being very thick in its proximal half and becoming more flattened and tapered towards the tip. *Manis crassicaudata* has the terminal scale right at the tip of the ventral surface of the tail whereas the Chinese Pangolin *Manis pentadactyla* which occurs in Assam, Bangladesh and Nepal has a naked glandular area at the tip of its tail (Roberts and Viellard, 1971).

Females are generally smaller in build than males. An exceptionally large male found killed on the road near Kohat weighed 11.3 kg (25 lb) (Guy Roberts, in lit.). Finn (1929) refers to a female which weighed 9.1 kg (20 lb) and produced a baby weighing 0.45 kg (1 lb) at birth. A typical average male from Las Belas measured 66 cm (26 in.) head and body and 56 cm ( $22\frac{1}{8}$  in.) tail with hind-feet 11.5 cm ( $4\frac{1}{2}$  in.) and an adult female measured 60 cm ( $23\frac{5}{8}$  in.) head and body with the tail of 46 cm ( $18\frac{1}{8}$  in.).

**Distribution and Status:** The Pangolin though well adapted to desert regions is very locally distributed in Paki-

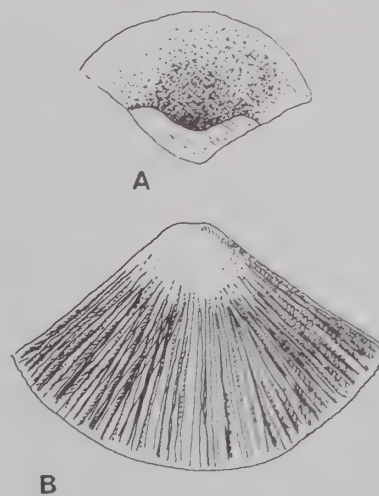


Fig. 32 Showing detail of body scales of *Manis crassicaudata*.  
A. Ventral surface of scale showing flattened reinforced undersurface of point which is not attached to underlying body skin.  
B. Dorsal view showing longitudinal striations basally with convex posterior margin where scale adheres to body skin.



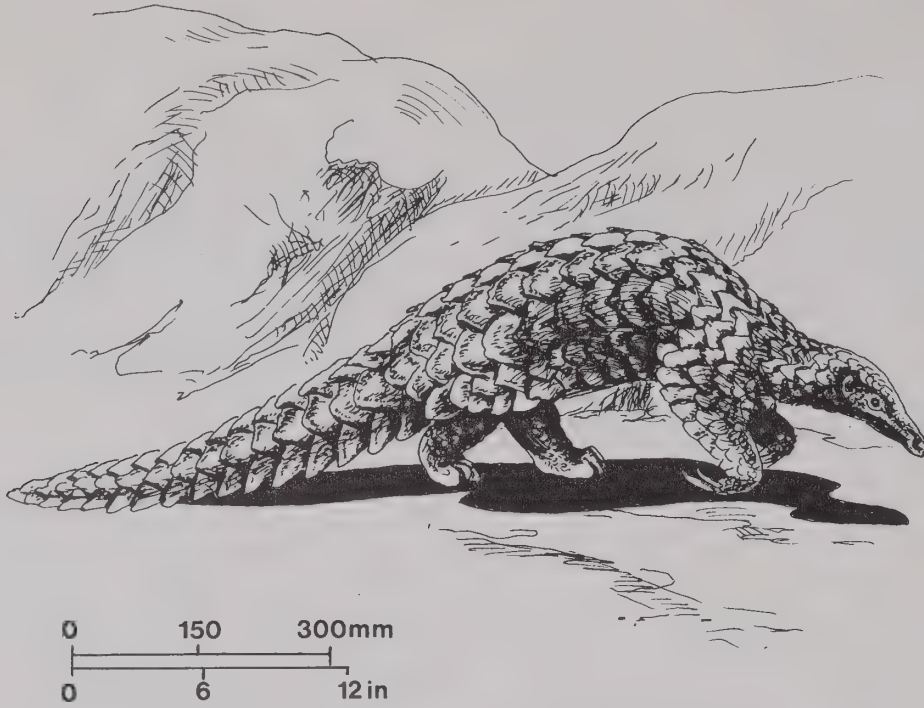


Illustration 18 *Manis crassicaudata*: Indian Pangolin or Scaly Anteater. (Based on live captive specimen from Jhelum, Punjab, juvenile female.)

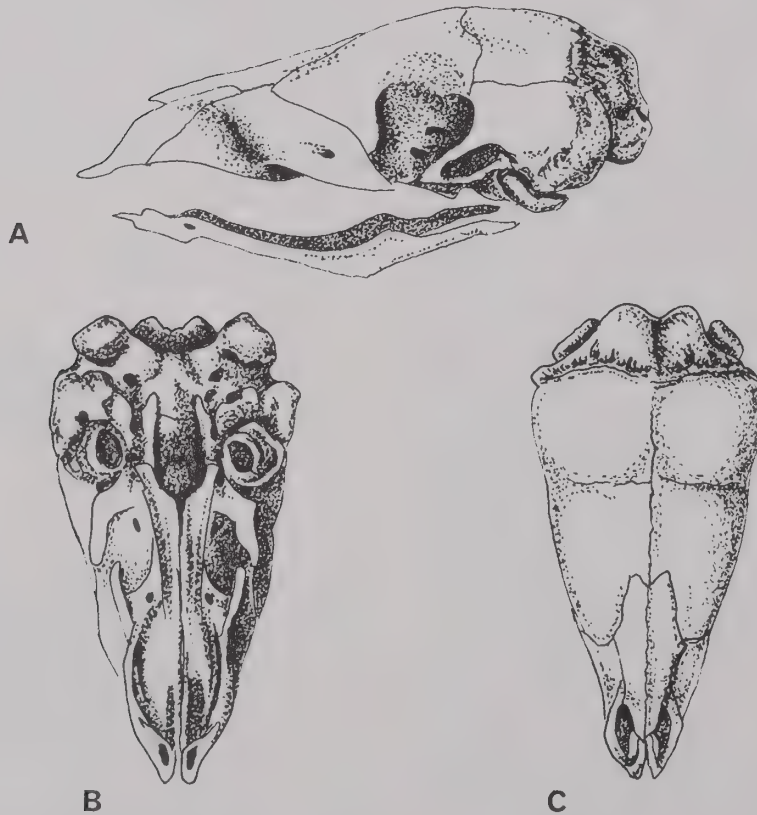


Fig. 33 Showing skull of female *Manis crassicaudata*.  
 A. Lateral view showing weakly developed lower jaw and absence of teeth.  
 B. Ventral view.  
 C. Dorsal view.



*Manis crassicaudata*

#### Distribution Map 38 Indian Pangolin or Scaly Anteater.

stan, and seems to prefer the more barren hilly districts. It is found in Sialkot, Jhelum and Gujrat Districts in the north west of the Punjab and extends across the Salt Range into Kohat District and also from Campbellpur District up to Mardan and Peshawar in the North West Frontier Province. It occurs in the subtropical thorn forest of the loess plateau of the Potwar as well as the Salt Range, and extends up to 750m (2500ft) elevation in the Rawalpindi foothills. There is no evidence of its having extended down into the Indus riverine plain nor has it been recorded in the Thal Desert. Absent from Bahawalpur and northern Sind it does occur on the left bank of the Indus in the hilly regions in the western part of Dadu and Larkana deserts. It also extends southward through Las Belas and Mekran. Specimens have been collected from the Hubb River valley as well as the Kirthar Range. It also occurs in Hyderabad district and Tharparkar, extending eastwards to Kutch and has been collected near Malir.

Elsewhere this Pangolin is widespread through the Indian peninsula down to Ceylon, but it has not extended its range either into Iran, Afghanistan or Russia.

Judging from the limited records of its occurrence the Pangolin is comparatively uncommon in Pakistan. Because of its specialized feeding habits it is highly beneficial to man. The direct economic damage done by termites both to agricultural crops and buildings must run into many hundred thousands of rupees annually in Pakistan. Unfortunately it enjoys no special protective status and it is often killed when encountered, as local 'Hakims' (Practitioners of country medicine) consider various parts of its body as a valuable source of medicines. In some regions and particularly in Sind its scales are reputed to have aphrodisiac qualities. (Murray, 1884, *Sind Gazetteer*, 1968).

**Biology:** The Pangolin is a highly specialized and adapted feeder. Some of the African species of this genus feed on a variety of crustaceans and arthropods as well as insects, but the Indian Pangolin seems to feed exclusively on termites and ants and their eggs.

Except during the mating season they are unsocial creatures living singly in underground burrows which they

excavate themselves. They normally feed at night and spend the day in their burrows, though they will occasionally emerge to forage during the daytime, as one was observed at 4.30 pm in bright sunlight on 10 September by E. Cunningham while he was driving between Kallar Kahar and Khushab (pers. comm.).

When out foraging they are rather slow and deliberate in their movements and characteristically walk with the back arched and the tail held well clear of the ground. Despite their awkward looking hindfeet they can climb trees well, making full use of their tail which is partly prehensile and gripping firmly with their forelimbs. They frequently rear up on their hind-legs and are even capable of walking a few paces in this upright position using their heavy tails to assist in balancing. In foraging they rely largely upon an acutely developed sense of smell and it is believed that their hearing is poorly developed though their sight may be more acute. They can be heard audibly snuffling the ground as they search for subterranean termite and ant nests.

They are very efficient excavators and normally find their food by excavating the nests. They dig by powerful strokes of their fore-feet which are armed with tremendous claws and they can excavate in quite hard rocky ground. When locating a termite colony they will stop to snuffle the ground periodically and appear to change the direction of their excavations on the basis of information thus gained by scent. Every now and again they pause to push the accumulated loose soil backwards with their hind-feet. Often they lie on their side to dig (Underwood, 1945). Having reached an occupied nest the Pangolin feeds by rapidly extending its thin cylindrical protrusible tongue into the galleries. The tongue is copiously lubricated with saliva to which the insects adhere. In the process a certain amount of earth or rotting wood (according to circumstances) may also be swallowed. There is a special throat gland in the Pangolin which may well be associated with production of the lubricant for the tongue during feeding. The tongue actually has muscular roots which pass right down through the chest cavity and anchor onto the pelvis (Walker et al., 1964). Prater (1965) states that the tongue is covered with a sticky substance whilst Underwood (1945) whose pet Pangolin frequently licked his fingers indicated that the fluid is not particularly sticky.

Pangolins often excavate their burrows under large boulders or rocks and when inside seal up the entrance with loose earth so that the burrow is difficult to locate. Burrows have been excavated down to 2.15m (7ft) in arid stony soil and down to 6.15m (20ft) in soft soil (Prater, 1965).

As already indicated the Pangolin is a timid and inoffensive creature. No vocalizations have been recorded except a feeble hissing noise which they emit whenever alarmed or frightened. Their only defence consists of tucking their head in towards their belly and curling up under the broad scaly tail so that all the vulnerable parts of the body are protected. The strength of the dorsal and tail muscles when in this defensive position is phenomenal and it is quite impossible even for a strong man to uncurl the animal. W. W. A. Phillips tells the story of a Pangolin in Ceylon which reveals the immense strength of its tail. A villager came across a Pangolin which he clubbed and then carried homewards intending to eat it. He draped the animal around his neck but apparently it was only stunned and when it recovered consciousness it immediately tried to curl up round the villager's neck. The unfortunate villager was found by the trail strangled to death with the Pangolin still curled tightly round his neck (Ripley, 1965).

Despite its protective armour of scales, the Pangolin is no



doubt preyed upon by the stronger carnivores, which occur in the same remote hilly regions, such as the hyaena, wolves and probably Caracal Cats. The Pangolin being relatively clumsy and slow is probably frequently killed by vehicles on the roads at night. I have four records of specimens killed in this way. Nothing is known about their longevity in the wild. They are notoriously difficult to feed successfully in captivity. The best record for this species in captivity is just under two years (Crandall, 1964). Of three captive specimens brought to the Lahore Zoo in the past decade all died after varying periods and apparently the causes were starvation despite attempts to introduce them to a diet consisting of a semi-liquid paste of milk and minced-meat. Captive Pangolins will drink water by darting the tongue in and out rapidly at such speed as to turn the water into a froth.

Very little is known about the breeding biology of the Indian Pangolin. Prater (1965) records young born at various times of the year in India including January, March and July and he states that two young are occasionally born though one is more usual. In the dry north western part of India in Rajasthan a captive Pangolin gave birth to a baby in November (Prakash, 1960A). An occupied Pangolin burrow excavated by J. A. W. Anderson in early November in Las Belas contained a male and female indicating that breeding pro-

bably occurred at this time since they are normally solitary. This pair was shipped to Oklahoma Zoo, where the male shortly died. The female however gave birth to a single young on 16 January. On this slender evidence the gestation period may be 65–70 days. The newly born Pangolin at Oklahoma Zoo appeared well developed and quite large in size though it was paler in colour than the parent and its scales were quite soft (Ogilvie and Bridgewater, 1967). When three days old the baby measured 31 cm (12½ in.) from head to tail. A nearly-full-term foetus in the Karachi Museum was fully covered with scales but these were short and not overlapping, leaving a narrow border of naked skin between each scale. In order to suckle its offspring the female has to lie on her side and the baby also lies on its side so that the two are vent to vent. This captive born baby was described as suckling with loud noises. Whilst the baby is small the mother protects it by coiling her body around it most of the day. In an account of the breeding of the closely related Chinese Pangolin (*Manis pentadactyla*) the young was born with eyes closed and they opened on the ninth day (Masui, 1967). The young appear to be weaned at three months of age and from about one month of age they are fairly active and climb onto their mother's tail where they are carried clinging crosswise near the base of the tail when the mother goes out foraging.

## 8 CARNIVORA

This order comprises 7 families and about 100 genera, consisting typically of mammals adapted to feed on vertebrate prey, though some species such as the Bears, are adapted to an omnivorous diet and can subsist to a greater or lesser degree on vegetable matter.

The Carnivores are characterized by having only four digits on the hind foot, large conical canine teeth and 6 small incisors of roughly equal size in both jaws (see Fig. 34). Furthermore they have a reduced number of cheek teeth with the pre-molars being especially enlarged and modified for shearing flesh. Instead of having a flattened or corrugated surface for grinding up food particles, their pre-molars tend to form relatively sharp edged lobes, which can be likened to the blades of a scissors in their action.

The females have their mammae situated ventrally (never pectorally), and the males have a baculum. The gestation period is usually comparatively short with the weakly developed new born young receiving extended care from the mother. Delayed implantation of the fertilized ova occurs in the Bears and some of the Mustelidae.

The brain is relatively well developed, and among the mammalian orders these animals are comparatively more intelligent and resourceful.

### FAMILY CANIDAE – WOLVES, COYOTES, JACKALS, FOXES

Comprising the Dogs, Jackals, Wolves and Foxes, the family has about 14 genera and about 35 species, of worldwide distribution. They are adapted to a cursorial predatory form of hunting with relatively elongated and slender limbs. The fore feet have 5 digits but the first digit is vestigial, the hind feet have 4 digits and the claws are non-retractile. The external ear pinna is pointed with a well developed bursa on its outer margin. The tail is relatively long with a scent gland located dorsally in the proximal region which is usually marked by a patch of black hairs.

Their reproductive biology is interesting, in that females normally only come into oestrus once a year or at six monthly intervals. Prior to ovulation there is extensive bleeding in the females and this scent attracts the males. Foxes, Jackals and Red Hunting Dogs have been observed to exhibit the post-coitus tie or 'knotting', a phenomenon whereby the male remains united to the female for a considerable period even after they have separated bodily.

#### Key to the Family Canidae in Pakistan

Five toes on fore feet of which the fifth does not come into contact with the ground. Claws non-retractile. Muzzle long. Tail long and bushy. No stripes or spots on body.

#### Genus CANIS Linnaeus, 1758

##### Key to the Genus CANIS

Tail less than two-thirds head and body length. Skull heavy and deep with strong dentition.

#### Key to the Pakistan Species of CANIS

- (a) Large size. Males measure up to 65cm at shoulder. Skull at least 18cm and up to 24cm long. First upper molar with outer cingulum indistinct.  
... *Canis lupus*
- (b) Medium size. Height at shoulder about 40cm. Skull 13cm up to 14.5cm in length. First upper molar with outer cingulum prominent.  
... *Canis aureus*

#### CANIS LUPUS

*Canis lupus* Linnaeus, 1758; the wolf.

Subspecies *Canis lupus pallipes* Sykes, 1831; the Indian wolf (see Illustration 19).

*Canis lupus chanco* Gray, 1863; the Tibetan wolf.

**Description:** The Indian wolf averages considerably smaller in size than the population inhabiting the boreal and sub-arctic regions of the northern hemisphere. A large male of the sub-species *C. l. pallipes* weighed 24kg (52lb) (Burton, 1915). An especially large male from Jath State in Rajasthan (India) stood 71cm (2ft 4in.) high at the shoulder and measured 1.5m (4ft 10in.) from nose to tail tip (Chavan, 1931). An adult male from Sidhnai in the southwest Punjab measured 67cm (26½in.) at the shoulder. Females are considerably smaller standing 50cm (20in.) or less at the shoulder. The sub-species *C. l. chanco* may reach up to 76cm (30in.) at the shoulder. The Timber Wolf of Canada is even bigger than this with males reaching 97cm (38in.) at the shoulder. There is very little record of colour variation in the Pakistan population in contrast to wolves in Canada and Russia where both white and black forms frequently occur. The majority of specimens known from Pakistan are the usual greyish-fawn colour. In Tibet and Ladakh however, black forms of *C. l. chanco* frequently occur but there are no known instances from Pakistan territory. A white specimen was secured near Quetta in Baluchistan which presumably belonged to the sub-species *C. l. pallipes* (Battye, 1942).

In a typical specimen the legs are ochraceous in colour, paler on the insides. The body is covered with long coarse hair of a grizzled colour with black hairs being predominant in the dorsal region and there is a crest of longer hairs along the back of the neck and the shoulders. This crest is thicker and more conspicuous in the sub-species *C. l. chanco*. The belly fur is soft and creamy-buff in colour. The face is greyer having a mixture of black and white hairs, being blacker on the forehead with predominantly white and fawn hairs around the eyes. The back of the ears are reddish-buff and they are pointed and upstanding. The iris is pale greyish-yellow and the naked lips and gums are black. The rhinarium is also black and rugose. The short bushy tail barely reaches to the hocks and is black tipped with black hairs predominant on the dorsal surface. Captive specimens of the sub-species *chanco* from Gilgit and *pallipes* from Cholistan have been exhibited together at Lahore Zoo. They were virtually identical in colouring though in winter the longer thicker coat of the Gilgit specimen was particularly noticeable as was its



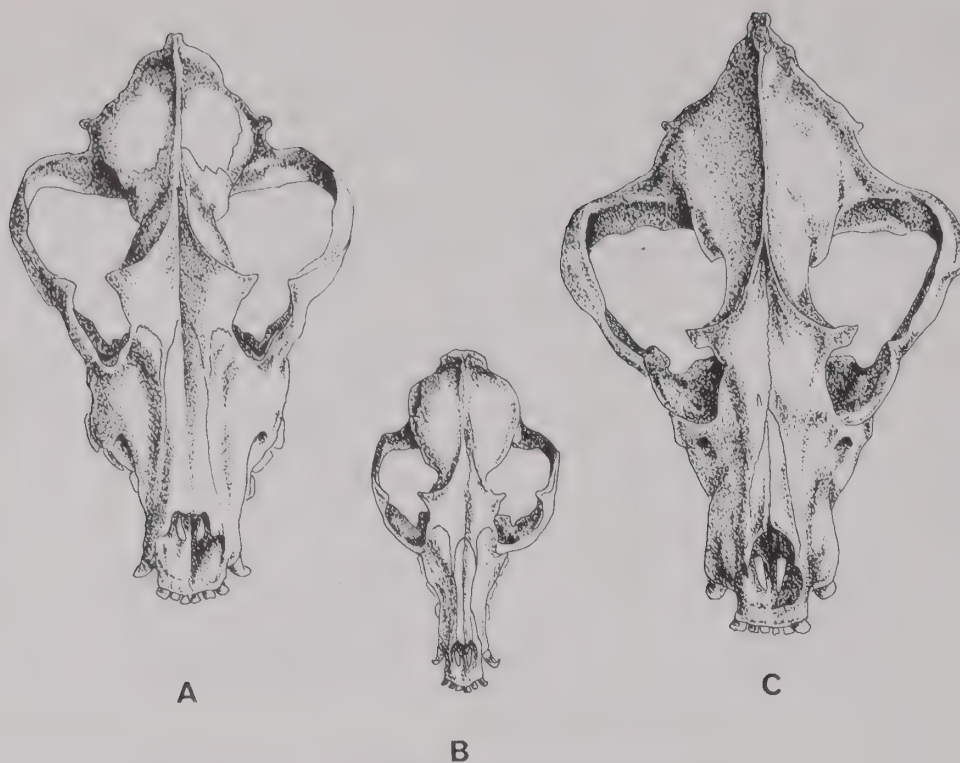


Fig. 34 Showing dorsal view of skulls of *Carnivora*.

A. *Canis lupus*.

B. *Vulpes vulpes pusilla*.

C. *Hyaena hyaena*.

Note relatively elongated maxillary bones with three pairs of approximately equal sized incisors.

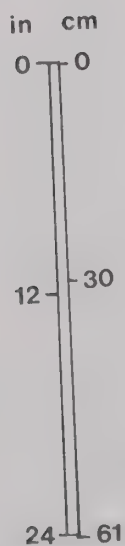


Illustration 19 *Canis lupus pallipes*: Indian Wolf. (Based on sketches of live captive specimens, Bahawalpur Zoo from Yazman, Cholistan.)

luxuriant neck ruff. Specimens from Baluchistan appear to be intermediate between these two sub-species.

**Distribution and Status:** The wolf is a great roamer and may occasionally occur in almost any type of habitat but generally it avoids natural forest regions as well as densely populated or well cultivated areas. It is mainly confined to the remoter tracts of extensive desert of barren hilly regions. It ascends into all the mountainous regions of Pakistan from Baluchistan up to Gilgit and Chitral in the north.

At the present time the sub-species *pallipes* has become extremely rare throughout the Indus plains and it survives mainly in extensive desert regions such as Cholistan and Tharparkar. Up the late 1940s it was relatively plentiful in Sind (Eates, 1968). During the years 1897–1907 no less



*Canis lupus*

Distribution Map 39 Wolf.

than 1178 wolves were destroyed in Sind according to Government records (Eates, op. cit.). At the present time very few wolves occur outside of the extensive uncultivated tracts though individuals have been seen during the 1970s in the Kirthar range, the Murri-Mongthar Hills and in Thatta District near Haleji River. In July 1960 I watched an adult wolf on Ghizri Creek on the outskirts of Karachi city itself.

In the Punjab two young wolves were observed near Renala Khurd on 8 November 1972 and a few must still survive in that region as a cub was captured in 1970 from the same area and an adult wolf was observed near Kharrar Jheel in 1967 (Mountford, 1969). An adult male was killed near Sidnai in October 1964. In the Salt Range wolves were regularly seen in the 1940s, but the game watchers at Kalabagh Urial Sanctuary report that they have been totally exterminated in that area since the past twenty years.

The wolf is still widespread throughout Baluchistan and the northern mountainous regions of Chitral, Swat Kohistan and Gilgit. It is undoubtedly much less rare in the northern Himalayan regions than anywhere in the plains judging by the frequency of tracks encountered in valleys such as Naltar and Khargah. Several wolf skins are brought into Chitral bazaar each year by traders who state that the wolf is wide-

spread in the mountainous regions but nowhere common. It is reported to be more plentiful up in Baltistan. It is less common in the North West Frontier Province but occurs widely in that region. In Baluchistan its range appears to extend over the whole province from the Mekran coast up to Zhub.

The status of the Indian wolf is much the same in India where it has become extremely rare as a result of increased human settlement as well as persecution. *C. l. pallipes* occurs sparingly throughout Iran. Though in the northern mountain regions it is probably replaced by *C. lupus chanco* it does not extend into the forested regions of north east India nor into Malaysia.

The wolf is persecuted by man because of its depredations on domestic flocks of goats and sheep and it is likely to continue declining in Pakistan though it may survive in the remoter less settled mountainous areas of Baluchistan, Gilgit and Baltistan whilst the subspecies *pallipes* is only likely to continue to survive in the remoter areas of Cholistan, Sibi and Mekran.

It is probably of no very great economic significance now that it has become so rare and may even be of some value in Pakistan since it frequently kills for food feral domestic dogs or village curs.

**Biology:** In the Indus plain wolves live in burrows which they excavate themselves, generally in the side of sand-hills or under the roots of trees. In mountainous areas they occupy natural caves or excavate burrows under boulders. Near Derawar in Cholistan an occupied burrow was excavated in completely flat ground.

In the mountainous regions of Pakistan they appear to live and hunt in pairs or family groups. They are mainly nocturnal in activity though adult wolves with dependent young will hunt by daylight also. Young wolves generally remain with their parents and hunt in a family group for the first few months of their lives but human persecution generally forces such packs to break up fairly quickly. A pack of ten wolves was reported doing great damage amongst goat flocks in the lower Chitral Valley (Fulton, 1903). This number was probably the result of two combined family groups, or a litter and several adults. Out of six chance encounters with wolves in the Indus plains, which I recall, two were of pairs — one of three adults and the remainder of single individuals.

Wolves feed on domestic goats and sheep whenever they get the opportunity but in the mountainous regions the bulk of their diet is probably made up from wild ungulates. There is an authentic account of wolves coursing and catching hares near Bhuj in Rajhastan. A hare put to flight in quite open country was overtaken and killed in about two minutes (Lester, 1896). In Baluchistan there is evidence that they occasionally succeed in killing wild sheep (*Ovis orientalis*) and wild goats (*C. bircus* and *C. falconeri*). And in Gilgit and Baltistan they prey on *C. ibex* and probably *P. nayaur*. They will also frequently kill domestic dogs and even show a preference for this form of cannibalism on the outskirts of mountain villages where such prey is often easy to obtain and relatively plentiful in contrast to well guarded and penned flocks of goats and sheep. Studies in Canada showed that juvenile wolves will also supplement their diet with small rodents and small birds (Cowan and Guiget, 1964, Canadian Wildlife Service, 1960).

According to studies in the USA wolves often form pair bonds lasting for several years (Mech, 1970). Females are sexually mature at two years of age and the males at three years (Crandall, 1964). The gestation period is about 63 days



and the female only comes into oestrus condition once in twelve months. Breeding of *C. l. pallipes* in captivity (Jaipur Zoo) has been described. After a 68 day gestation period five young were born. They were covered with dark brown rather short woolly hair and their eyes remained closed until the eighth day. They were suckled until eight weeks of age. The female did not come into oestrus again until eight months after the pups were weaned (Yadav, 1968). In Pakistan most litters are probably produced in late winter and early spring. A lactating female was observed by me at close range in Nawabshah District of Sind in late February. A female was reported to have a den containing young near Fort Derawar in early March (Lt. Gen. J. H. Marden, pers. comm.). An aged captive female in Lahore Zoo produced four young in January. In the mountainous regions further north birth of the young is probably confined to the warmer months. A litter of five cubs, three males and two females were captured when about two weeks old in late April at about 2450m (8000ft) elevation near Wam in Baluchistan. These cubs were artificially reared and one of the females which was weaker from the start was literally starved to death by its stronger siblings (T. Robertson, pers. comm.). A litter of five cubs believed to be about two weeks old was also found in Chitral in May (Fulton, 1903). A litter of five young was captured in February in Kathiawar (India). This comprised two males and three females (Prakash, 1960A).

Both parents share in feeding the young and regurgitate food brought to the den when the pups are small. As they grow up fresh killed game is brought. Captive Indian wolves have lived for 10, 13 and 15 years (Dover, 1933). Life expectancy in the wild is believed to be 14 to 16 years (Walker et al., 1964).

## CANIS AUREUS

*Canis aureus* Linnaeus, 1758; Asiatic jackal (the Golden jackal of Africa) (see Illustration 20).

**Description:** It is generally accepted that the population occurring throughout Pakistan belongs to the nominate subspecies *C. a. aureus*. In general appearance it is a small edition of the wolf with relatively shorter legs and slimmer muzzle. An adult male stands from 38–43cm (15–17in.) at the shoulder and has a head and body length of 60–75cm (23 $\frac{5}{8}$ –29 $\frac{1}{2}$ in.) In the plains the average weight varies between 7 and 9kg (15–20lb). In the northern Himalayan regions the population comprises larger individuals and males may weigh up to 12.2kg (26–27lb).

The body fur is rather coarse and wiry with a sandy-buff appearance. The mid dorsal region as well as the back of the tail bear predominantly black hairs, the belly, chest and inside of legs creamy white and the face and lower flanks being grizzled more grey. The backs of the ears are brownish buff with an indistinct darker border and the upright pointed ears are comparatively smaller than those of any fox species encountered in Pakistan. The tail has a black tip. The naked lips and rhinarium are black. The hairs around the eyes and lips and throat are whiter and the outer surfaces of the legs and lower flanks are a warmer ochraceous colour.

**Distribution and Status:** Like the wolf this is a very adaptable animal, readily entering mountainous areas, forest plantations and riverine thickets. It is well adapted to dry open country and generally avoids extensive natural forest though it is extremely numerous in irrigated forest plantations.

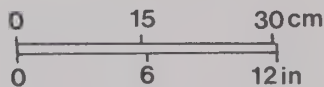


Illustration 20 *Canis aureus*: Asiatic Jackal. (Based on sketches of live captive specimens Lahore Zoo, origin unknown.)



Canis aureus

Distribution Map 40 Asiatic Jackal.

In Pakistan the jackal is found throughout the plains and throughout Baluchistan and the North West Frontier Province. In the summer months, at least, they can regularly be found in the forested hills of Hazara District and the Murree Hills up to 2150m (7000ft) elevation. Though they do not penetrate into higher mountain regions they may be found in most of the broader Himalayan valleys. They are not uncommon in the southern part of Chitral State around Drosh as well as the southern part of the Kunhar valley and I have seen them at Shogran in June in pine forest at 2150m (7000ft) elevation. They particularly frequent larger towns attracted by refuse and garbage and they are common around Quetta though not found in the higher mountain ranges of Baluchistan. Though occurring, they are relatively scarce in extensive desert tracts as the Thal or Cholistan, where the desert subspecies of the Common Red Fox (*Vulpes v. pusilla*) is particularly abundant.

In the irrigated canal colonies there is some evidence that jackals have decreased in number in recent years which might be the result of increased human disturbances as well as the effect of chemical pesticides which are usually highly toxic to mammals. Certainly it is rare to hear jackals calling at night around the outskirts of many larger towns in the Punjab and Bahawalpur, where in the 1950s their nightly chorus of calls was common-place.

As carriers of diseases like rabies as well as raiding sugar cane or orchard crops, the jackal may be harmful to man but all available evidence of their food habits would seem to indicate that they are of far greater benefit in controlling rodent populations particularly in crop areas.

**Biology:** The popular conception of the jackal in the Indo-Pakistan sub-continent is as a scavenger and carrion eater. Such a reputation does not do justice to the intelligence and resourcefulness of this animal. They will eat carrion whenever encountered and no doubt search for all forms of edible refuse in the precincts of villages and towns at night-time. However the bulk of their diet comprises rodents, and reptiles secured through hunting and they will freely supple-

ment their diet with fruit and insects when available. The stomach contents of four Jackals examined from the semi-desert regions of Rajasthan (India) were found to contain mostly the fruits of *Zizyphus* with a small quantity of chitinous pieces of Dung Beetles (*Helicopris bucephalus*) and scorpions (*Palaemneus species*). Another individual had the remains of Desert Jirds (*Meriones hurrianae*) and the Small Mongoose (*Herpestes auropunctatus*) in its stomach (Prakash, 1959A). Examination of faecal remains of Jackals living on the outskirts of Sal Forest in eastern central India showed that rodents' remains were found in 68 per cent of their droppings, with vegetable matter (fruits and seeds) about 26 per cent and reptiles' remains about 11.6 per cent (Schaller, 1967). Jackals living in the high ranges of southern India also subsisted mainly upon rodents 94 per cent with lizards and snakes comprising 29 per cent and insects 6.7 per cent of their faecal remains (Schaller, 1970). There have been no detailed studies in Pakistan but in Khanewal region they can often be seen feeding on ripe fallen mulberries (*Morus alba*) during the month of April and during November (in Khanewal) they regularly visit the ground underneath Pipal trees (*Ficus religiosa*) to pick up the fallen fruits. Once in October during the late afternoon a pair of jackals were observed at Sidhnai in the southwest Punjab, plunging through water 10 or 12cm (4 or 5in.) deep and hunting in unison in order to catch frogs. Tame jackals kept as household pets by C. H. Donald, in the Himalayas were observed to consume a great quantity of insects during the monsoon season (Donald, 1948). After rains, a pet female could smell emerging Crane-fly larvae (*Tipulidae* spp.) on a garden lawn and dug them up by the hundreds. The same pet jackal even when seemingly asleep could hear the drone of flying Cockchafer Beetles (*Scarabaeidae*) and unerringly ran to the bush or plant that the beetle was approaching and succeeded in snapping it up (Donald, op. cit.). Jackals will rob any bird's nest which they encounter but their principal food in Pakistan probably comprises gerbils and jirds. Normally jackals are timid animals but there is an account of one observed in daylight, repeatedly attacking a goat which had been tethered as bait for a panther (Simons, 1933). In Baluchistan there is evidence from talking to several local hunters that jackals frequently kill and eat hedgehogs.

Though normally hunting singly they are social in habits and invariably call to each other as they emerge in the early evening, each individual joining in an answering chorus of yelping and barking. Usually one individual emits a long drawn-out wail followed by three to five rapidly repeated and high pitched yelps which are taken up by other individuals within hearing. Usually they emerge from cover to start hunting in the late afternoon while it is still daylight. They are not particularly afraid of man as long as the latter's approach is not close.

Jackals will excavate their own burrows. According to C. H. Donald's (1948) observations of a semi-wild female, she excavated a separate den before giving birth to young. A litter near Malir in Sind was produced inside a man-made road culvert. At certain seasons of the year however Jackals frequently lie up by day in the cover of thick crops and do not use burrows. This characteristic was made use of by the Peshawar Vale Hunt in former times. In the winter months the hunt never failed to find jackals lying up in sugar cane crops (I. R. Grimwood, in lit.). S. H. Prater (1965) states that jackals breed throughout the year in India. In Pakistan I have only obtained evidence of breeding during the spring and summer months. Donald, (1948) whilst living in the Himalayan foothills allowed his pet female to mate with wild males on three



separate occasions. This female only came into oestrus once a year, during February, litters being born in the second week of April. The gestation period is known to be normally 63 days (Naaktgeboren, 1968). In mid March in Pirawala plantation, I have observed a male apparently in pursuit of an oestrus female. It was in a very excited state with its tail held almost vertically and the hairs on its neck standing up. A litter of four jackal pups about one month old were captured in early June in Pirawala plantation. One of these which was kept by an office messenger became very tame. A litter of five, three females and two males was found under a road culvert in late April near the Karachi University campus. These were hand reared until about four months old and it was noticeable throughout the period that the females were much tamer and easier to handle than the male pups. In play and exploration it was also the female jackal pups of this litter who gave the lead, the males being much less aggressive and more nervous. When the tail was slightly lifted but the distal part still hanging vertically this was a characteristic sign of aggressive intentions (Gloria Walton, pers. comm.). In the wild the adult male jackal is an attentive mate and guards the entrance to the breeding burrow when the young are newly born. Later he assists in procuring food and a wild male was actually observed regurgitating food at the entrance of a breeding den (Donald, op. cit.). Newly-born jackals observed at Bahawalpur Zoo had dark sooty-brown hair and at six days of age their eyes were still closed and they were too feeble to crawl.

Male jackals, like most of the *Canidae*, regularly scent their territory by depositing urine on conspicuous bushes and grass clumps. In late April in the Margalla Hills a jackal was encountered about 9.00 am emitting a series of dog-like barks quite different from their usual contact call before going out hunting. It was probable that this was a mate attracting call. K. R. Eates (1968) once observed two jackals attack and kill an obviously weaker and sickly individual.

Like the wolf, the jackal has been successfully crossed with Alsatian dogs and the offspring themselves have been fertile and able to breed which shows the very close relationship between domestic dogs and jackals. Captive specimens of the Indian jackal have lived up to 12 and 15 years (Dover, 1933).

### Genus VULPES Oken, 1816

This genus, comprising the foxes, contains nine species ranging over most of North America, Europe, Asia and northern Africa. They are smaller and lighter in build than the Genus *Canis*, with a longer more bushy tail, and relatively shorter legs. The external ear pinna is larger and taller in relation to the head size when compared with jackals and wolves.

### Key to the Genus VULPES

Ears comparatively large and tail at least three-quarters of head and body length and very bushy. Skull distinguished from other genera of *Canidae* by having the forehead between the post orbital processes flat.

### Key to the Pakistan Species of VULPES

(See Figs. 35 and 36)

- (a) Hind foot about 110–150mm long. Dorsal surface of ears black. Tip of tail white, pads of feet naked. Body fur with chestnut and white-tipped guard hairs.  
... *Vulpes vulpes*.

- (b) Hind foot 110–120mm long. Back of ears sandy brown. Tip of tail black. Pads of feet naked.  
... *Vulpes bengalensis*.
- (c) Hind foot about 95–110mm long. Small size. Body fur with guard hairs predominantly black. Back of ears buff. Tip of tail mainly black, occasionally white at extreme tip. Pads of feet naked.  
... *Vulpes cana*.
- (d) Hind foot 100mm. Ears relatively enormous and dark brown dorsally. Tip of tail white. Pads of feet covered with long hairs.  
... *Vulpes rüppelli*.

### VULPES VULPES

*Vulpes vulpes* Linnaeus, 1758; Common Red Fox.

Subspecies *Vulpes vulpes pusilla* Blyth, 1854; Desert Fox or White-footed Fox.

*Vulpes vulpes griffithi* Blyth, 1854; Kashmir or Hill Fox (see Illustration 21).

*Vulpes vulpes montana* Pearson, 1836; Tibetan Red Fox.

**Description:** The Common Red Fox is a very variable species both in size and general colouration. No less than thirty-eight different subspecies are listed by Ellerman and Morrison-Scott (1951), for the palearctic and Indian regions alone. In Pakistan there are three fairly distinct populations.

The Red Fox is readily distinguished in the field from jackals (or the Red Hunting Dog) by its smaller size and relatively longer more bushy tail. The tail is tapered bearing very long hairs in its proximal region. In full winter coat the basal part of the tail is almost as wide as the animal's body. The muzzle is more slender than that of a jackal and the ears are relatively larger. The tip of the tail is always pure white and the backs of the ears are velvety black or very dark brown. This ear pattern distinguishes all races of the Red Fox from any other species inhabiting Pakistan (see Fig. 35). The hair around the pectoral region is generally slaty-grey varying to black and there is an admixture of rusty-red hairs in the dorsal region. There is a patch of black hairs midway between the eye and the nose on the upper part of the muzzle. The iris is a golden-brown colour and the rhinarium is black. Females generally have three pairs of mammae though I have obtained a specimen in the Murree Hills which had four pairs. The male has a baculum.

*V. v. pusilla*: This subspecies is characterized by its comparatively smaller size and lighter build. Also it has much shorter body fur and a less bushy tail. The pelage colour is much greyer when viewed from a distance with only faint speckling of rust-brown hairs. The outer limbs and the paws often have extensive white areas on them. In one specimen collected from the south west Punjab, the dorsal surface of the ears was dark brown rather than pure black. Two adult specimens from Khanewal had the head and body length 49.5 and 56.5cm (19½ and 22¼ in.) with the tail 33 and 34cm (13 and 13½ in.). The hind foot varied from 122–132mm (4¾–5¼ in.) and the ear 84–91mm (3¼–3½ in.).

*V. v. griffithi*: This subspecies inhabiting temperate regions in the mountains, is larger in size with a thick and luxuriant fur in winter coat. The backs of ears are always jet black and the longer hairs in the dorsal region are banded with white and rusty orange giving the fur a very handsome appearance. The inside of the ears are thickly fringed with white hairs. The throat and chest region varies from dark grey to

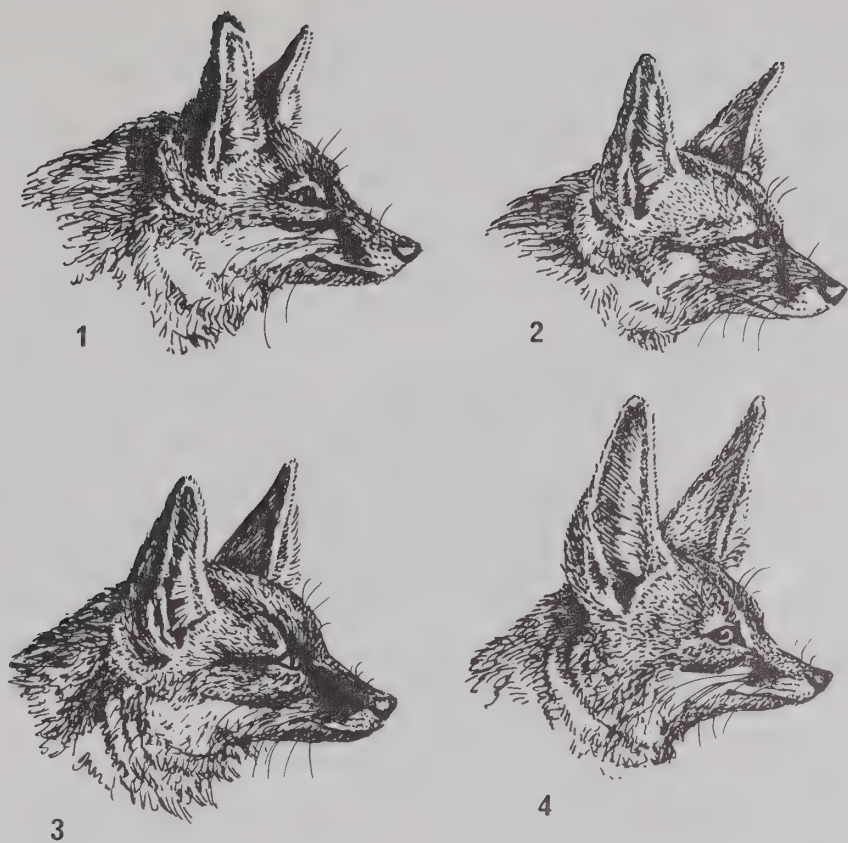


Fig. 35 Showing heads of Pakistan fox species.  
1. *Vulpes vulpes griffithi*.  
2. *Vulpes bengalensis*.  
3. *Vulpes cana*.  
4. *Vulpes rüppelli*.  
Note variation in dorsal pattern of ears with characteristic area of black hairs on muzzle.



Fig. 36 Showing tails of Pakistan fox species.  
1. *Vulpes vulpes griffithi*. Note thick bushy brush with prominent white tip.  
2. *Vulpes bengalensis*. Note tail less bushy with prominent black tip.  
3. *Vulpes cana*. Tail relatively thick and bushy in

relation to length with black-tipped hairs predominating throughout and distal portion occasionally white tipped but generally more solidly black.  
4. *Vulpes rüppelli*. Tail less bushy having white tip and conspicuous black caudal patch of hairs.





Illustration 21 *Vulpes vulpes griffithi*: Kashmir or Hill Fox. (Based on live captive specimen, adult male from near Dunga Gali, Murree Hills.)

black and the dorsal part of the tail has an admixture of black guard hairs. The outer fur of the limbs is generally dark grey. Melanistic forms occur in Hazara District and one skin obtained from the Kaghan Valley in 1970 by Major I. R. Grimwood was almost completely black with only faint brownish tinges in the dorsal region. Two specimens, one from the Murree Hills and a second from Baluchistan measured 65 and 52cm ( $25\frac{1}{2}$  and  $20\frac{1}{2}$ in.) head and body length with the tail 41 and 39cm ( $16\frac{1}{4}$  and  $15\frac{1}{4}$ in.) respectively. The hind feet measured 14cm ( $5\frac{1}{2}$ in.) in the Murree Hills specimen and 13.5cm ( $5\frac{1}{4}$ in.) in the Baluchistan specimen, the ear lengths being 90mm ( $3\frac{1}{2}$ in.) and 96mm ( $3\frac{3}{4}$ in.) respectively.

*V. v. montana*: This fox is more uniformly red in body colour and therefore more like the European races of the Common Fox. It also has a dense woolly blue-grey under fur in winter. The tail, as in other races is white tipped with an admixture of black hairs in its dorsal region but there are much fewer grey and buff tipped hairs mixed in the contour hairs of the body with rust red tipped hairs being predominant. This subspecies averages slightly larger than *V. v. griffithi* though it has not been possible to find any fresh body measurements of this subspecies from localities within Pakistan. Specimens from the Indian Himalayan regions and Ladakh had the head and body length averaging about 66cm (26in.) with the tail about 43cm (17in.) and the hind foot 15cm ( $5\frac{7}{8}$ in.).

An adult male specimen from the Himalayas of the subspecies *V. v. griffithi* weighed 3.86kg ( $8\frac{1}{2}$ lb) and a female weighed 3kg ( $6\frac{1}{2}$ lb) (Burton, 1915).

**Distribution and Status:** The Common Red Fox avoids heavy forest but can be found in any type of open country. In the Indus plains it prefers extensive uncultivated tracts with sand-dunes. It occurs throughout the mountainous areas of Baluchistan, the North West Frontier Province and the Himalayas, both in the valleys and higher mountain slopes as well.

The subspecies *V. v. pusilla* is still relatively common in extensive areas of desert such as the Thal, Cholistan and Tharparkar. In one afternoon's drive through the Thal, eight individuals of this subspecies were encountered in broad daylight in 1957. It is common in the Salt Range and all the specimens from that region examined by me correspond with the subspecies *pusilla* contrary to what is stated by S. H. Prater (1965) who states that *V. v. griffithi* occurs in the Salt Range. The subspecies *V. v. griffithi* occurs throughout the southern Kohistan, Dir and the southern part of Chitral. It is also found throughout Azad Kashmir and the Murree Hills. In the mountainous regions of the North West Frontier Province and Baluchistan the Common Fox is widespread and specimens correspond in appearance and size to the subspecies *griffithi*. Specimens from south west Baluchistan tend to have more reddish body fur and are rather different in colour from typical Murree Hill specimens but there is insufficient collected material to determine whether there are any very distinct geographical differences. Some specimens from northern Baluchistan have been observed in the spring to have a thick bluish-grey underwool with very sparse scattering of rufous tipped guard hairs.



*Vulpes vulpes pusilla* (vertical lines)  
*Vulpes vulpes griffithi* (horizontal lines)  
*Vulpes vulpes montana* (stippled)

Distribution Map 41 Desert or White-footed Fox.  
 Hill or Kashmir Fox.  
 Tibetan Red Fox.

The subspecies *V. v. montana* occurs in the Brughal area of northern Chitral and judging from the number of skins which are brought each year to Chitral bazaar they are relatively plentiful in these northern regions. They also are found in north western Gilgit around Ishkoman extending eastwards through Hunza and Baltistan. In 1967 a forest official, Mr. Manzur-ul Haq showed me a fine rug made from 12 matching skins of this subspecies all of which had been collected around Skardu in Baltistan.

Extra-liminally the Common Red Fox occurs throughout the northern hemisphere but it has not extended eastwards into India beyond the district of Rajasthan and the Himalayan range in the north. The Red Fox of North America, *Vulpes fulva* is considered by some authorities to be conspecific with *V. vulpes*. In Africa it extends only into the Nile Valley in the north.

The Hill Fox is ruthlessly hunted in the north for its valuable pelt yet it is still widespread in the Himalayan regions of Pakistan. In the extensive desert regions to the east of the Indus plain it is still relatively common.

**Biology:** Outside the breeding season, the Red Fox lives singly and is not social in its hunting habits. They are largely nocturnal but in the winter time may be seen hunting by day in desert areas. I have also encountered Hill Foxes in mid-afternoon during cloudy monsoon weather out hunting. They are adaptable hunters capable of capturing hares, rodents, reptiles and occasionally small birds. When vertebrate prey is not available they can subsist on insects and fruit. In the Thal Desert they eat the half-ripe buds of the gram crop (*Cicer arietum*) during March. In June in the Suleiman Hills a specimen was observed feeding greedily on the ripe fallen fruit of the Ber tree (*Zizyphus mauritiana*) (Waite, pers. comm.). A specimen shot in the Murree Hills had its stomach partly filled with the berries of *Viburnum nervosum*. In Chitral according to examination of their droppings, foxes feed principally on mice and rats followed by fruit. In winter rose hips

are the main fruit eaten. (G. B. Schaller, in lit.). In the late afternoon in the Soon Valley of the Salt Range a hare was encountered being pursued by a fox and it was apparent that the fox was hunting by scent though very close upon the heels of the hare (*Lepus nigricollis*). No doubt they use vision as well and I have seen foxes at night pouncing upon gerbils (*Tatera indica*). Studies in Rajasthan (Prakash, 1959A) showed that the desert population of this fox ate the wild melon (*Citrullus vulgaris*) as well as termites (*Anacanthotermes macrocephalus*). Another Desert Fox had 25 scorpions in its stomach plus the fruits of *Zizyphus nummularia*. A third had the remains of *Meriones burrianae* and the Camel Spider (*Galeodes agilis*), a cockroach and some melon seeds in its stomach.

Surprisingly I have never encountered any authentic cases in Pakistan of domestic poultry having been killed by this fox though I have come across instances of such predation by Civet Cats, mongooses and martens.

According to detailed studies in Europe, foxes form a fairly long pair bond during the breeding season though there is as yet no evidence that the male feeds the female at the den. (Southern, 1964). The gestation period is about 50–53 days and in the plains litters are usually born in late winter or early spring and breeding is only once a year. Near Khanewal a litter of four cubs was found on 16 April, which were then estimated to be about five weeks old. In Rajasthan a litter was found in late January (Prakash, 1960A). Generally four to five young are produced, occasionally as many as six. Generally the female excavates a special burrow in which the young are born. One such burrow near Khanewal was located in a standing sugar-cane crop and consisted of a steeply sloping tunnel about 2.5m (8ft) long which widened into a chamber 1.25m (4ft) below the surface. The burrow was 23cm (9in.) wide at the mouth and there was practically no excavated earth visible in the immediate vicinity of the tunnel mouth indicating that the female fox had carried this dirt and deposited it in less conspicuous surroundings. The chamber was not lined inside but was quite clean, and presumably the vixen had regularly removed the cubs' faeces. There was a strong doggy odour in the chamber. New-born foxes are fully furred but their eyes do not open until the ninth day (Naaktgeboren, 1968). Studies in Europe indicate that young foxes do not emerge above ground from the den until they are about three-and-a-half weeks old. In Europe this fox is believed to mate for life with pairs occupying the same breeding den year after year. There is no evidence as to whether this is the case in Pakistan. In the Himalayas litters are produced in the late spring or early summer. Male foxes mark their territory by urinating on bushes and during the breeding season or rut they bark a great deal at night. This is a quickly repeated high pitched yappy call and is thought to be associated with territorial behaviour. The call of the female is harsher and more like a grating bark than a yap.

*V. v. pusilla* has lived for 11 years in captivity (Dover, 1933). In Europe this fox is thought to have a mean life expectancy in the wild of about four-and-a-half years (Southern, 1964).

#### VULPES BENGALENSIS

*Vulpes bengalensis* Shaw, 1800; Indian or Bengal Fox (see Illustration 22).

**Description:** Noticeably smaller than any of the races of the Common Red Fox, the Indian Fox is also readily distinguished in the field by the prominent black tip to its tail. In





Illustration 22 *Vulpes bengalensis*: Bengal Fox or Indian Fox. (Based on live captive specimen in possession of J. A. W. Anderson, collected near Thatta, Sind.)

general body colouration it is also greyer than races of *Vulpes vulpes* found in the plains. Some individuals are more yellowish-grey whilst others are more silvery-grey but in all races there is no mixture of rusty red hairs as in *Vulpes vulpes*. The backs of the ears are a dark brown, with their margins black. The naked rhinarium and lips are black and there is a smudge of black hairs around the upper part of the muzzle in front of the eyes. The female has six mammae. Adult males weigh from 2.7 to 3.2kg (6–7lb) whilst females weigh under 1.8kg (4lb). The head and body length varies from 45–60cm (18–24in.) whilst the tail varies from 25–35cm (10–14in.).

**Distribution and Status:** This fox is generally associated with open country having a scattering of trees and it is not found in extensive sand-dune desert areas nor in forest. It also avoids mountainous regions.

In Pakistan it shows the distribution of a typical oriental faunal zone species. It is only relatively common in the southern half of Sind province and the north east corner of the Punjab around Lahore and Sialkot. In Sind it is sympatric with *Vulpes vulpes* being particularly common in Thatta District where it frequents broken stony ground with tropical dry thorn scrub characterized by *Acacia senegal*. It has also been recorded further westwards in Las Belas.

To the north it is not uncommon around Kasur and Lahore and has been collected in Bahawalnagar as well as near Fort Abbas on the fringes of the Cholistan Desert. There are no records of its occurrence in the Salt Range further north though a few individuals have spread westwards further south, as specimens have been recorded at Khanpur in Bahawalpur Division as well as in Khanewal in the southern Punjab. It is noteworthy however that these are isolated records in regions where *V. vulpes* is relatively plentiful.

This fox is much more widespread and common throughout India, extending from the Himalayan foothills to the tip of the peninsula. It has not been recorded either from Afghanistan or Iran.

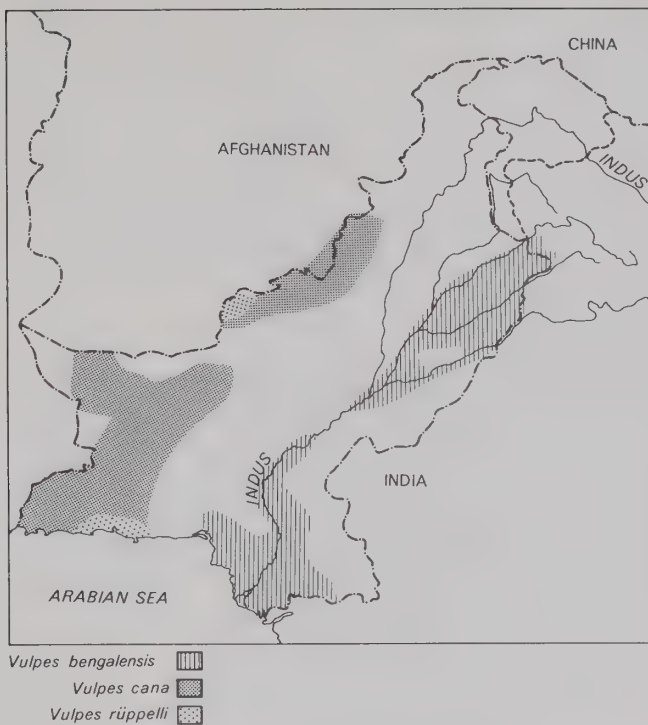
**Biology:** Like the Common Red Fox it hunts mainly by night and also supplements its diet with ripe fruit whenever available. In Sind it has been observed to be particularly fond of the ripe fruits of Banyan trees (*Ficus bengalensis*). It has also been observed eating the ripe berries of the Neem tree (*Melia azedarachta*) (Eates, 1968). A specimen from Rajasthan (India) had its stomach full of wild melon seeds (*Citrullus vulgaris*), the fur of *Tatera indica* and the remains of scorpions (*Palaemneus* sp.) (Prakash, 1959A). This little fox appears to be quite omnivorous in feeding habits and well able to supplement its diet with insects. It also appears adept at digging out lizards from their burrows as well as being able to catch frogs. Observations on a captive specimen indicated that it is able to climb low trees as well as vertical wire netting and it seems to be more agile than *Vulpes vulpes*. A captive specimen in south India thrived on an almost meatless diet of milk, rice and plantains (Webb-Peploe, 1947).

Like the Red Fox it excavates its own burrows and these are sometimes occupied for several years at a stretch. Prater (1965) records that the young are born between February and April, and four is the usual litter size.

#### VULPES RÜPPELLI

*Vulpes rüppelli* Schinz, 1825; Rüppell's Fox or Sand Fox.

**Description:** This fox is closely similar to the desert races of the Common Desert Red Fox in general appearance



Distribution Map 42 Indian or Bengal Fox.  
 Blanford's or King Fox.  
 Rüppell's or Sand Fox.

and size. It, however, averages slightly smaller in size with a more pallid yellowish-buff body colouring and comparatively larger ears. The enormous ears are its most distinctive feature, and their dorsal surface is ochraceous-brown not black (see Fig. 35). The inner part of the ear pinna is thickly fringed with white hairs. The tip of the tail is white though the amount of white is often not very extensive. As in all the foxes there is an area of black tipped hairs in the upper proximal part of the tail marking the region of the caudal gland. In two captive specimens seen by me this black patch about three inches from the base of the tail was very conspicuous. Rüppell's Fox, in contrast to *V. v. pusilla*, which is sympatric, besides having a paler dorsal surface to the ears has the lower jaw, chest and belly buffy-white and the soles of the feet are unique amongst all other fox species in the region being completely covered with long soft fawn hairs which conceal the pads. As in other foxes there is a smudge of blackish hairs across the muzzle in front of the eyes and the rhinarium and lips are black. The outer surface of the legs are more rufous buff than the rest of the body. Specimens of this fox in the British Museum collection from Arabia have the head and body length varying from 40–52cm (15 $\frac{3}{4}$ –20 $\frac{1}{2}$ in.) with the tail varying from 25–35cm (9 $\frac{3}{4}$ –13 $\frac{3}{4}$ in.). The ear varies from 95–100mm (3 $\frac{3}{4}$ –4in.) in length, compared with the ears of *Vulpes vulpes* which vary from 80–95mm (3 $\frac{1}{8}$ –3 $\frac{3}{4}$ in.). The skull of Rüppell's Fox averages about 25 per cent shorter than typical skulls of *V. v. pusilla*.

**Distribution and Status:** Rüppell's Fox is highly adapted to desert conditions being typically associated with rolling sand-dune areas in Pakistan. It however, inhabits areas of stony desert in Arabia. In Pakistan it appears only to have penetrated into southern Baluchistan being absent from higher mountainous regions. In 1910 the Afghan Boundary Commission collected a specimen from Chaman on the bor-

der of Afghanistan. There are no other authentic records until 1966 when two cubs were collected from Ormara in the Mekran coastal area. These specimens were sent by an animal exporter to Detroit Zoo, USA, where they were still alive up to 1970. Undoubtedly this fox must be considered the rarest *Vulpes* species in Pakistan occurring only sporadically in the border regions of south west Baluchistan.

Elsewhere, Rüppell's Fox is sparsely distributed from southern Algeria eastwards through Libya, Egypt and the Arabian peninsula. A specimen was collected 130km (80 miles) south east of Tehran in Iran (Lay, 1967). It has also been collected in Kerman Province in south east Iran. According to Ellerman and Morrison-Scott it ranges into Afghanistan (1951) though it has not been recorded there recently (Hassinger, 1968). (See Distribution Map 42.)

**Biology:** Practically nothing has been recorded about this fox which inhabits remote desert regions. In the Sahara groups of three and five foxes were observed together but these may have been family parties and do not necessarily indicate gregarious habits (Harrison, D. L. 1968). Harrison observed them in Arabia around garbage dumps indicating that they are scavengers. Dorst and Dandelot (1970) believed that they are more insectivorous in diet than other fox species.

In Pakistan it has been collected in areas where there are extensive colonies of such rodents as *Meriones libycus* and *Gerbillus nanus* which must provide an important part of their diet. The litter of two cubs which was found at Ormara (referred to above) was dug out of a burrow in a sand-hill in late March. They were presumably born in early March.

## VULPES CANA

*Vulpes cana* Blanford, 1877; Blanford's Fox or King Fox.

**Description:** This beautiful fox is characterized by its small size and dense luxuriant fur. In the field its size with tail almost equal to body size and dark blackish pelage serves to distinguish it from the larger *Vulpes vulpes griffithi*. The tip of the tail in *V. cana* is generally black with numerous black tipped hairs throughout its length though the extreme tip may be white in some specimens. The ears which are relatively smaller than in *Vulpes vulpes*, are thickly fringed with white hairs inside with their dorsal surface being greyish-brown with pale buff margins. The face has a slender and delicate muzzle and the mask is grizzled silvery-grey with a conspicuous black band across the upper part of the muzzle and below the eyes (see Fig. 35). The lower jaw is usually blackish-grey whereas the throat and chest are white with the hair being very long and silky in this region. The lower limbs are more ochraceous-buff and in winter coat there is a dense underwool in the dorsal and flank regions. There is some variation in individual appearance with many specimens having a generous sprinkling of white tipped hairs in the dorsal region which gives the pelage a beautiful appearance. Not surprisingly this species is highly prized by the fur trade. A specimen from near Kharan in Baluchistan had the head and body length 422mm (16 $\frac{1}{2}$ in.), the tail 298mm (11 $\frac{3}{4}$ in.) with the hind foot 78mm (3.1in.) and the ear 74mm (2.9in.).

**Distribution and Status:** It is confined to mountain steppe regions characterized by barren rocky hills interspersed with stony plains and small patches of cultivation. It appears to avoid the higher mountain ranges as well as lower warmer valleys. It occurs mainly in south west



Baluchistan and judging from the trade skins which come to Quetta bazaar it is largely confined to the northern hill regions of the Mekran spreading northwards through Kalat and Kharan. Specimens have been collected from Gwadar in the Mekran, Turbat in the extreme south west of Kharan as well as Chagai. Whitehead purchased a skin (now in the British Museum) which had been collected at Bajaur in north Waziristan. Skins regularly appear with fur traders in Peshawar which are alleged to come from the frontier of Kurram and Khyber agencies. The scant amount of museum material representing this species indicates that it is rare in northern Baluchistan and the North West Frontier Province and may be slightly more plentiful only in south west Baluchistan. There are no records of its occurrence in the northern Himalayan ranges.

Elsewhere it appears rare in Iran where it has only been collected from Fars and Khuzistan (Lay, 1967). It is known to occur in Afghanistan though neither Niethammer (in lit.) nor Hassinger (1968) succeeded in obtaining any specimens during extensive collecting. It occurs sparsely in a few localities of south west Russia including Uzbekistan, Bokhara and Turkestan (Bobrinskii et al., 1965).

In 1970 a raw skin of this fox in Quetta bazaar was worth Rs.70.00 (£6.35) and it is remarkable that it has survived such continuous persecution for its fur. (See Distribution Map 42.)

**Biology:** According to the evidence of local hunters in Baluchistan, Blanford's Fox is probably more frugivorous than other species occurring in Pakistan. It is particularly fond of ripe melons which are an important cash crop in Kalat region. It is also reported as feeding on the ripe fruits of *Eleagnus hortensis* (the Russian Olive) which is planted around villages in Baluchistan. In the early autumn it feeds on the seedless grapes which are cultivated in the valleys of Baluchistan. It is probably this species which has been observed feeding on locusts in Kalat region (Mumtaz Ali Khan, Locust Control Entomologist, pers. comm.). No doubt it feeds on lizards, and various rodents which also abound in these semi-desert regions.

Nothing has been recorded about its breeding habits or vocalizations.

**Genus CUON** Hodgson, 1838

**CUON ALPINUS**

*Cuon alpinus* Pallas, 1811; Indian Wild Dog, Red Dog or Dhole.

The Red Dog is not included in the checklists for Pakistan published by the Zoological Survey (Siddiqi, 1961 and 1971). However it is briefly mentioned here since it is still possible that this species occasionally enters Pakistan territory in Baltistan. Col. A. E. Ward (1927) writing about the mammals of Kashmir and adjacent states considered it very rare in the main Vale of Kashmir but commoner in the Indus Valley in Baltistan. He saw skins of this species in the fur shops in Srinagar. Lydekker (1907) also gives the range of this species as Gilgit and Kashmir as well as Ladakh and Spiti. For many decades there has been no detailed zoological survey conducted in Baltistan area and recent Russian publications show the occurrence of the Red Dog in the areas of Uzbekistan and Turkestan bordering on Pakistan (Flint et al., 1965 and Bobrinskii et al., 1965).

## FAMILY URSIDAE — BEARS

The Bear Family comprises seven genera and nine species distributed throughout the northern hemisphere with one species represented in South America. No bears occur in Africa, Australia or Antarctica.

Characterized by their large rounded heads, bulky size and short stumpy tails, they are of considerable zoological interest because they are well adapted to a mainly frugivorous and herbivorous diet as well as being able to undergo hibernation or partial hibernation in winter.

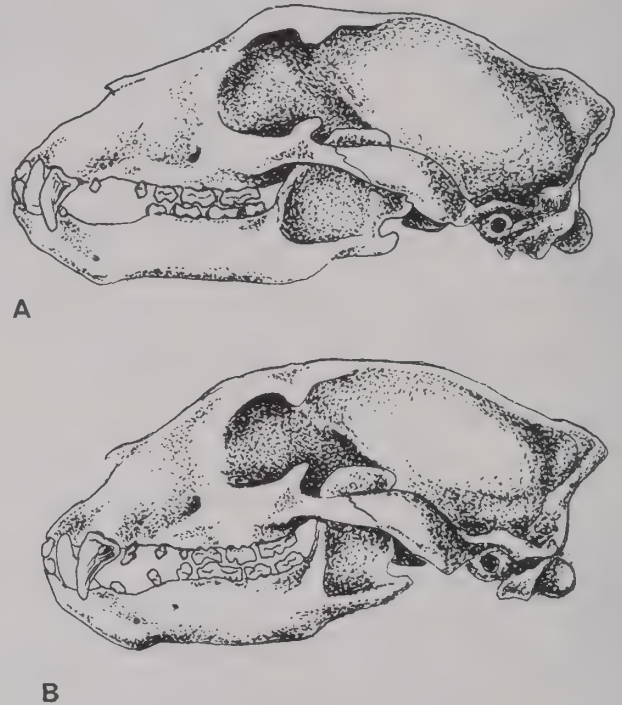


Fig. 37 Showing lateral view of skulls of bears.

- A. *Ursus arctos*. Note presence of only first pre-molar in upper jaw with no second and third pre-molar in lower jaw. Also, longer muzzle with more developed orbital ridge.
- B. *Selenarctos thibetanus*. Note second and third pre-molars though smaller and peg-like, occur in both upper and lower jaws. Also shorter muzzle with more rounded profile over temporal ridge.

## Key to the Family URSIDAE

Very large size, head and body over 1m and tail reduced to a mere stump. No carnassials, cheek teeth being tuberculate. Four prominent lower cheek teeth. Hind feet with five digits.

## Key to the Pakistan Genera of URSIDAE

Carpal pad on forefeet restricted to a small naked internal pad. . . . Genus *Ursus* Linnaeus, 1758.

Carpal pad on forefeet as wide as plantar pad and more or less fused with it (see Fig. 38). . . . Genus *Selenarctos* Heude, 1901.

## Key to the Pakistan Species of URSIDAE

- (a) body fur black with a creamy-white mark on the chest . . . *Selenarctos thibetanus*

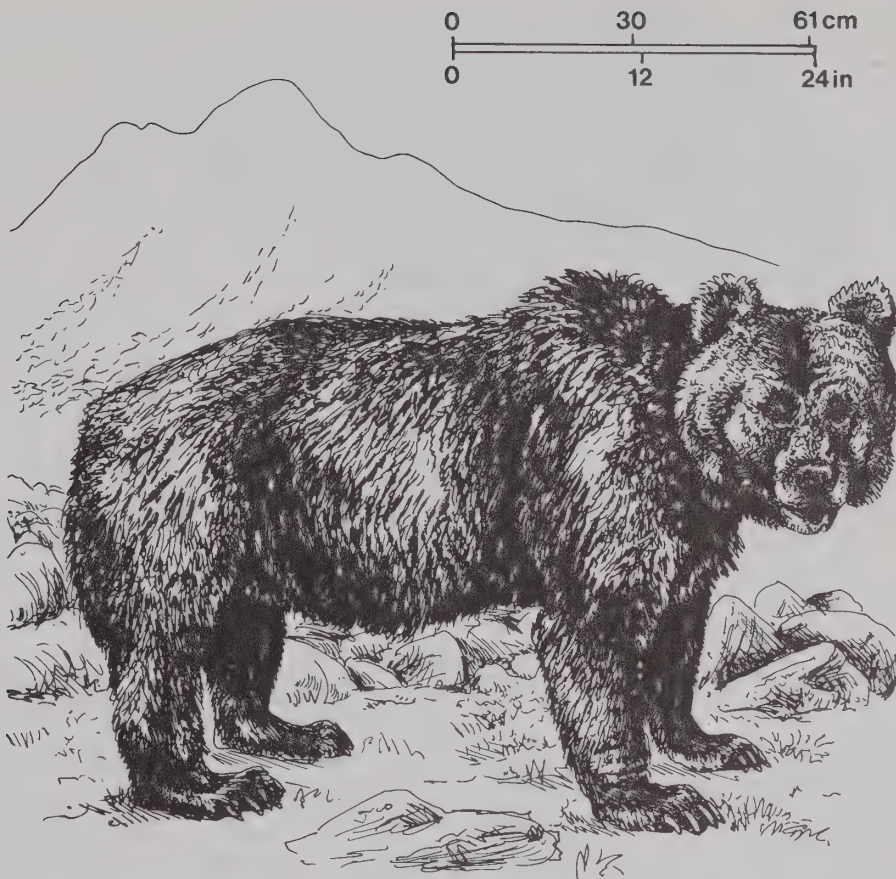


Illustration 23 *Ursus arctos*: Brown Bear or Snow Bear.  
(Based on live captive specimen, adult male from Gilgit.)

- (b) body fur reddish or isabelline-brown without any white mark on chest.

... *Ursus arctos*

**Genus** *URSUS* Linnaeus, 1758.

#### **URSUS ARCTOS**

*Ursus arctos* Linnaeus, 1758; Red Bear, Brown Bear or Snow Bear (see Illustration 23).

Subspecies *Ursus arctos isabellinus* Horsfield, 1826.

**Description:** The Red Bear of the Himalayas varies much in size but generally specimens grow larger and are longer limbed than the Himalayan Black Bear. There is some sexual dimorphism with females being smaller and lighter in build. The Red Bear is variable in colour and generally appears a sandy or reddish-brown colour from a distance. Their pelage is long and tends to be matted with dense underwool. The longer guard hairs are bleached a silvery blond or isabelline brown with the newly grown hair after moult a darker reddish-brown. There is a conspicuous hump of longer hairs over the shoulders and no noticeable ruff of longer hairs on the neck as in the Himalayan Black Bear. The ears are small and rounded and the lips are noticeably protrusible and mobile. The second pre-molar is generally absent so that the dental formula is  $i - 3; c - 1; pm - 3; \text{and } m - 2$  (see Fig. 37). The Himalayan Black Bear has four pre-molars. The claws vary from horn to whitish colour, those of the forefeet being particularly long and strong.

Wing Commander Shah Khan of Hunza State described (pers. comm.) a specimen shot near Domel which was a male of especially large size. It was 91cm (3ft) in circumference around the neck immediately in front of the shoulders. Adult males vary from as little as 1.5m (5ft) head and body length up to 2.2m (7ft). Females vary from 1.37m (4ft 6in.) to 1.83m (6ft) when measured over curves (Pocock, 1941). The tail in adult specimens is generally about 7.6cm (3in.) long.

**Distribution and Status:** The Himalayan Brown Bear is generally restricted to alpine meadow and sub-alpine scrub zones above the tree-line though it will descend to remoter side valleys or ravines with stunted *Juniperus* and birch (*Betula utilis*) forest in search of succulent food plants. Its range is therefore generally allopatric with the Himalayan Black Bear.

In Pakistan this bear occurs very sparsely in all the higher mountain ranges. It is now rare even in the northern parts of Chitral though it probably still occurs in the Turkho and Yarkun Valleys where it was once considered plentiful (Fulton, 1903). It also occurs in Swat, Indus Kohistan, Gilgit and Baltistan. Its main stronghold is undoubtedly in Baltistan particularly in the lower Deosai Plateau region. It also occurs around the slopes of Nanga Parbat and Astor. According to local hunters a very few still survived in the early 1970s in Hazara District in the Siran Nullah. Due to scant rainfall even at high altitudes in the western part of the Himalayas the habitat for this bear is less suitable and its population is much more sparsely distributed than is the case further eastwards. Ellerman and Morrison-Scott (1951) include





*Ursus arctos* [diagonal lines]  
*Selenarctos thibetanus* [cross-hatch]

Distribution Map 43      Red or Brown Bear.  
    Himalayan Black Bear.

Waziristan in the distribution of this bear. This seems to be based upon old unconfirmed records and this bear has not even penetrated as far south as the Safed Koh Mountains in contrast to the Black Bear.

Outside of Pakistan the subspecies *U. arctos isabellinus* extends from the Hindu Kush and the Pamirs in northern Afghanistan across the Himalayas to Nepal, Sikkim and northwards to Tianshan in south east Russia (Pocock, 1941). It is now considered by most authorities that this subspecies is conspecific with such widely diverse populations as the Giant Alaskan Brown Bear, the North American Grizzly and the stunted Syrian Bear of Asia Minor and the Caucasus.

**Biology:** Any visitor to the inner Himalayan uplands will be struck by the evidence of this bear's feeding activities wherever it occurs. It assiduously turns over rocks and stones in search of insects or small crustaceans sheltering beneath. In the spring and early summer months they feed presumably upon certain alpine bulbs and roots of plants which they grub up. Brown Bears will occasionally develop the habit of killing domestic goats and sheep. Gujar shepherds in the Deosai recounted to me how the previous year three goats were killed by a particular bear within a period of two months until they succeeded in shooting it. They are known to eat carrion whenever the opportunity avails and in the early spring to feed on the succulent shoots of young grasses and forbs. They have also been observed to dig up and eat voles (*Alticola* species) which are abundant in such alpine regions (Stockley, 1936). The Brown Bear, in studies conducted in the Italian Alps, was found to make up its diet as follows: fruit, 34.4 per cent; herbs, 32.2 per cent; meat, 15.1 per cent; insects, 14.7 per cent; other matter, 2.6 per cent (Florio, 1971).

The Brown Bear feeds actively from 1–2 hours before sunrise and again for several hours in the late afternoon and evening. It is nocturnal. Their sense of smell is acutely developed and believed to be their principal means of finding food.

However the Brown Bear has certainly developed keen eyesight as anyone can testify who has thrown morsels of food to captive begging specimens in a zoo.

The Brown Bear in Pakistan does not normally get the opportunity to climb trees but cubs encountered in Kashmir showed a ready inclination to climb a birch tree when surprised by a human intruder (Stockley, 1936). They have also been observed climbing rowan trees (*Pyrus aucuparia*) to feed on the berries (Pocock, 1941).

The breeding biology of bears is especially interesting since the female gives birth to her young just at the end of winter hibernation. The ova (generally two in number) are impregnated sometime during the summer months but the foetus does not start developing until after the female bear enters into hibernation in late autumn, at which time the ova becomes implanted into the wall of the uterus. Actual mating is believed to occur in the spring and early summer. Observations on captive specimens of the Himalayan subspecies in the London Zoo showed that mating occurred intermittently over a period of about three weeks and that the gestation period lasted for about 240 days (Pocock, 1941). Walker (1964) states that the gestation period was from 180–250 days. The cubs, generally two in number are blind and weigh no more than one pound at birth. They are covered with short silky rather dark brown hair. The cubs born sometime in January stay in the lair with their mother until she first emerges from hibernation in late April. The young bears stay with their mother until the autumn. Females are believed to breed first at the age of five years. There are records of other sub-species of this bear living in captivity for over 30 years.

Adult bears normally go into hibernation at the end of October and they excavate their own hibernating lair or den under some large boulder or between the roots of a stunted birch tree or they may utilize a natural cavern. Hibernation in this species is probably intermittent with the animal occasionally waking up and becoming active. A captive specimen from Gilgit region, kept in Lahore Zoo showed no inclination to hibernate even in mid winter season when the ambient temperature declined to 32°F on successive days. It is probable that low temperatures are more significant in triggering hibernation responses than any relative shortening of day and night lengths.

In the Himalayas this bear appears to have only one complete moult of its fur each year. Pocock describes this as starting at the end of June and continuing throughout July (Pocock, 1941). An adult observed by me on the Deosai Plateau in the second week of August had still not completed moult of its old winter coat which was coming off in ragged patches.

#### Genus SELENARCTOS      Heude, 1901

##### SELENARCTOS THIBETANUS

*Selenarctos thibetanus*      G. Cuvier, 1823; Asiatic Black Bear or Himalayan Black Bear (see Illustration 24).

Subspecies *Selenarctos thibetanus gedrosianus*      Blanford, 1877; Baluchistan Bear.

and *Selenarctos thibetanus laniger*      Pocock, 1932; Himalayan Black Bear.

**Description:** In the northern regions of Pakistan this bear has dense shiny black fur which reaches a length of up to 50mm (2in.) in the region of the back. However there is no under-wool in this species. There is a ruff of extra long

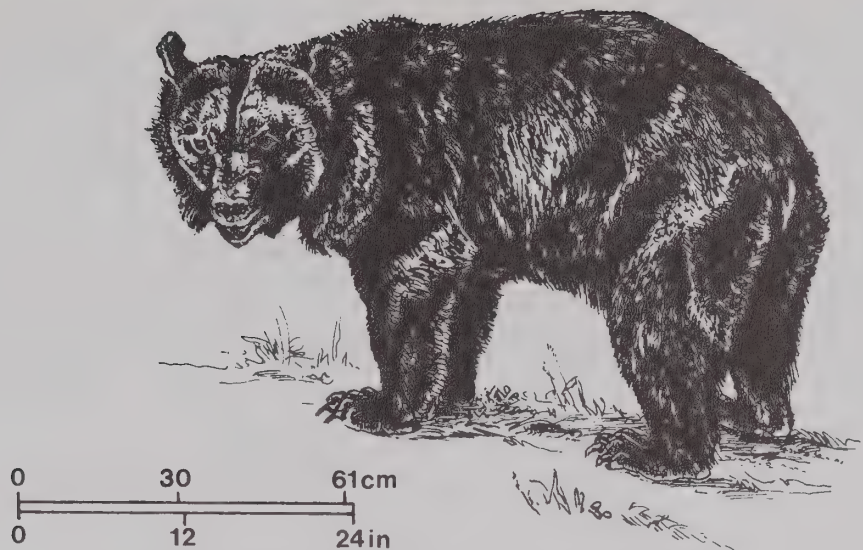


Illustration 24 *Selenarctos thibetanus*: Asiatic or Himalayan Black Bear. (Based on live captive specimen from Azad, Kashmir.)

coarse hairs fringing the cheeks and running down each side of the neck. These hairs are up to 155mm (6in.) in length in the autumn. There is a conspicuous creamy yellow V extending from the sternum up to the armpits (axillae of fore limbs), otherwise the rest of the body is jet black except for the muzzle which is reddish brown. The naked rhinarium is black. The profile of the skull is less dished than in the Brown Bear (see Fig. 37) and there are four pre-molars present in the upper jaw. The round ears are set wide apart on the crown with the tips bearing quite a long fringe of hairs so that they are generally more conspicuous and upstanding than in other bear species. The claws on the fore feet are horny black in colour, being shorter and more sharply recurved than those of *Ursus arctos*. They are therefore better adapted to assist in tree climbing than in digging and are adapted to its different food preferences. The Black Bear lacks any shoulder hump of longer hairs. The tail is just a stump measuring from 75–100mm (3–4in.) in length. Both fore and hind feet bear five digits with extensive naked black soles (see Fig. 38). They are plantigrade in gait. The fore paws tend to be turned inwards when walking and are very powerfully developed.

Males average larger in size than females and are particularly fat and heavy in the autumn. Col. Stockley (1962B) records an especially large male which weighed 173kg (384lb) and an adult female which weighed 47kg (105lb). Pocock (1941) refers to large male specimens weighing as much as 113kg (250lb) and measuring up to 1.83m (6ft) in length from nose to tail tip, measured over curves. Females are about 30cm (1ft) shorter.

The subspecies *S. t. gedrosianus* is mainly distinguished by its much smaller size. An adult male killed in July 1969 measured 1.67m (66in.) head and body length with the tail 80cm (3.12in.), hind foot 18.4cm (7.25in.), the ear 10.3cm (4.12in.). This specimen had a relatively restricted cream coloured mark on its chest and there was some rufescence to the tips of the body hairs. However there is considerable individual variation in the shape of the V mark on the chest even in the northern races of the Black Bear. The Baluchistan subspecies has comparatively short coarse fur and quite often this appears to get bleached to a reddish-brown colour. A live

captive specimen seen by J. A. W. Anderson in 1968 was dark reddish-brown rather than black (pers. comm.). Another fresh killed specimen seen in the late 1950s at Khuzdar was reddish-brown in colouration (S. M. Irshad, Divisional Forest Officer, pers. comm.).

**Distribution and Status:** The preferred habitat of this bear is Himalayan moist temperate forest but it will descend to tropical pine forest and also spreads northwards into regions of Himalayan dry temperate forest. Unlike the Brown Bear it does not ascend above the permanent tree-line into alpine regions.

At one time it appears to have had a continuous distribution through the dry mountain steppe forests to the west of the

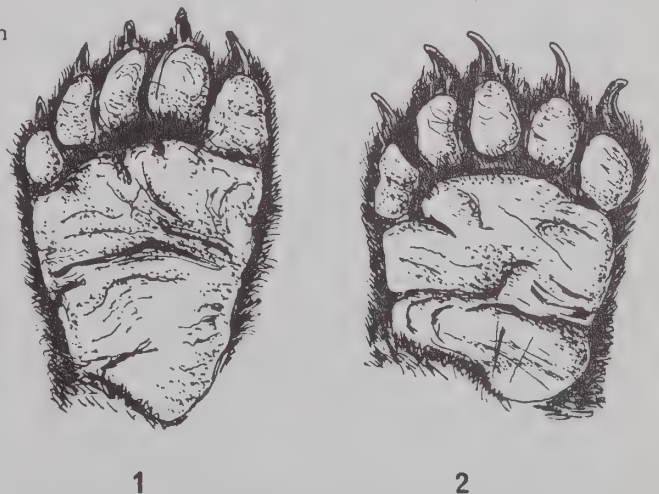


Fig. 38 Showing soles of feet of *Selenarctos thibetanus gedrosianus* drawn from fresh killed adult male from Baluchistan.

1. Left hind foot.

2. Left fore-foot.

Note fringe of hairs between digital pads and broad plantar pad.



Indus extending through the North West Frontier Province and Baluchistan. The Baluchistan subspecies is now mainly confined to arid subtropical thorn forest in southern Baluchistan in regions typically associated with the Dwarf or Mazri Palm (*Nannorrhops ritchieana*).

The Himalayan subspecies occurs in the Neelum Valley of Azad Kashmir and in the lower part of the Kaghan Valley in Hazara District including Sari and Shoghran Forest Reserves. It occurs sparsely in the Deodar forests of northern Dir and lower Chitral and specimens occasionally enter Chitral Gol behind Chitral town (I. Grimwood, in lit.). In Gilgit it occurs in Chilas extending southwards into Indus Kohistan and it also occurs sparsely in the forest around Astor. It is also recorded as far north as the Rondu Valley in Baltistan in pine forest (Pakistan Wildlife Inquiry Commission Report, 1969). The most plentiful evidence of this bear's survival according to my observations in recent years seems to be in the forests around Gabriel in north western Swat Kohistan.

There is plenty of evidence that it has declined drastically in numbers in the past 20 years, due mainly to persecution from local hunters. It used to be common in the Murree Hills up to the beginning of World War II. A hibernating specimen was actually killed near Khanspur in the Murree Hills in the late 1950s but in recent years only an occasional individual wanders into the region (Mirza Mohd Hassan, Deputy Ranger Wildlife, pers. comm.). The exact northern limit of the subspecies *S. t. gedrosianus* may be considered as northern Baluchistan.

Up to the 1940s a very few Black Bears still survived in the Safed Koh Mountain ranges and they may still occur there on the borders with Afghanistan. Col. Stockley records them as occurring in the Kuchmina Valley and in the hills west of the Zhob Valley in the 1930s in southern Waziristan. There is some evidence that a few Black Bear still survive in the Shingar Range north of Zhob Valley (Islam Khan, D.F.O., Loralai, 1972, pers. comm.) There is also some evidence that a few survive in the Takht-i-Suleiman region. Hamid Ali, D.F.O., Wildlife, found bear droppings in 1971 in blue pine forest (*Pinus wallichiana*). In 1951 a Black Bear was observed in north east Baluchistan at Wam Tangi north of Harnai (S. M. Irshad, D.F.O., pers. comm.), and in 1972 there were two sightings of bear in this region, one on the north slope of Kaliphat and one near Ziarat. Other than these scattered records there does not seem to be any significant population of this Baluchistan subspecies until one reaches the hill ranges of south western Kalat and Kharan. The main population of *S. t. gedrosianus* appears to be around the hills to the south of Khuzdar as well as the hills south west of Kharan. A few may still survive in the Pab Range of hills in Las Belas as well as in the Jhal Jao Hills to the north east of Kalat. Up till the middle 1920s it definitely occurred in the Kirthar Hills on the border of Sind and an old 'shikari' (hunter's guide) recalled to me (in 1966) the killing of a female with two cubs discovered in a cave around 1925.

The Black Bear has been ruthlessly hunted wherever it occurs because of its depredations to crops and there is no doubt that fire-arms, being more commonly available in northern hill regions in the past two decades, have increased the hunting pressure on this species. Forest operations which have led to the development of 'jeepable' roads into the last strongholds of this bear in the Himalayan regions have also hastened its decline. Young cubs are frequently captured apart from the shooting of adults when they come to feed in ripening crops. Cubs are sold to certain nomadic gypsy tribes who train them to simulate dancing and wrestling and thereby earn a living. I recall seeing one such roadside gypsy en-

campment with five Black Bears in 1973. In 1969 two Black Bear cubs were presented to the Lahore Zoo (which already exhibited five specimens), having been given to army officers serving near the Cease Fire Line in Azad Kashmir.

Elsewhere the Black Bear extends across the Himalayas in India and down as far as the Chittagong Hill Tracts in Bangladesh. It also extends through most of the western hilly regions of China and into the extreme eastern part of Russia in the deciduous oak forests of the Amur and Ussuri regions (Flint et al., 1965).

The Baluchistan subspecies is a relict isolated population adapted to surviving in a very arid treeless environment and is of great ecological interest. It has been listed in the I.U.C.N. Red Data Book though it has not been possible to enforce any measures for its protection in the tribal regions of southern Baluchistan where it precariously survives. (See Distribution Map 43.)

**Biology:** Living at lower elevations and in more human populated regions, this species is more nocturnal than the Red Bear though in secluded areas they will emerge to feed before darkness. They are more frugivorous than the Red Bear and climb trees freely in order to forage. In September and October they are particularly fond of acorns from the Hollyoak (*Quercus balut*) in the dryer regions and *Quercus dilatata* in the Kaghan Valley and Azad Kashmir. In the early summer months it feeds extensively on mulberries (*Morus alba*) and later on in June they raid apricot orchards (*Prunus armeniaca*). It commonly feeds by sitting in the fork of a tree and breaking off and pulling towards its mouth the surrounding branches with its fore paws (Schaller, 1969). In the Shoghran Forest area in Hazara it has been observed eating rose hips (*Rosa webbiana*). There are authentic cases of the Black Bear eating carrion and occasionally killing goats or sheep (Pitman, 1924 and Stockley, 1936). They also hunt for insects and small crustacea (arthropods etc.) turning over stones on the forest floor. I have observed in Gabriel Forest (Swat Kohistan) that it is also fond of certain species of fungus or forest mushrooms. In October it frequently raids the maize crops which are grown on hillside terraces up to 2150 or 2410m (7000 or 8000ft) elevation. In Chitral Black Bears were observed to eat considerable amounts of grass (Dr. Schaller, in lit. 1973). It is usually in stealing maize that they come into conflict with local villagers and the Black Bear has a reputation of being of uncertain temper and likely to attack human beings if suddenly disturbed. In 1946 I recall that there were two cases of persons being treated for wounds inflicted by this bear in the Civil Hospital in Srinagar, Kashmir but I have come across no records of such attacks having occurred in Pakistan.

The Baluchistan subspecies is known to eat the fruits of the Ber (*Zizyphus nummularia*) and the Russian Olive (*Eleagnus hortensis*). Undoubtedly in this region the species supplements its diet with lizards and all kinds of orthopterous insects including locusts which are sometimes plentiful in that region. As mentioned above, it is typically associated with the Dwarf Palm (*Nannorrhops ritchieana*). It has been observed to dig out and eat the thick starchy rhizomatous stems of this palm as well as eating its fruit and the association of this plant with the distribution of this subspecies of the bear is no doubt ecologically significant and has enabled its spread southwards through barren hills devoid of forest. The Baluchistan Bear also comes into conflict with man in the late summer when it raids the cultivated crops of Sorghum (*Sorghum sudanense*) as well as ripe dates (*Phoenix dactylifera*) in August.

The Black Bear digs its own burrow, generally under an over-hanging boulder, and considering its size it is capable of squeezing into a remarkably narrow crevice as has been observed at Lahore Zoo. Mating is believed to take place in October with the young being born in February while the female is still sheltering in her winter lair. As with the Brown Bear two young are generally produced though sometimes only one and they are very small and blind at birth. They stay with their mother throughout the summer.

In the Himalayas this bear generally goes into hibernation in winter and there is a record of one specimen being discovered in the hollow of a Deodar tree (*Cedrus deodara*) when this was being cut down near Drosh in lower Chitral in January (Skey, 1898). Similarly I recall a specimen being shot in a natural rocky cave below Khanspur in the Murree Hills in February. It was known to the local villagers to be hibernating in this cave. There is evidence that the Black Bear does not always undergo prolonged or deep hibernation as it will occasionally emerge to forage even during the winter months. In the winter of 1972–73 a Black Bear was active in December and January in the Chitral Gol Valley but this was thought due to the exceptionally heavy crop of acorns available locally in that winter (G. B. Schaller, pers. comm.). It wandered about in 12–18 in. deep snow. They select a variety of sites for hibernation, enlarge natural cavities under tree roots or crevices between rocks as well as entering hollow trees if large enough. Again, in captivity this species shows no inclination to hibernate in winter as observed from specimens in Lahore and there is no evidence as to whether the Baluchistan subspecies hibernates or not.

When fighting or attacking, this bear makes lightning swipes with its fore paws and it can inflict terrible injuries with its claws. It is a regrettable fact that in Pakistan even up to the time of writing, it is still possible to see captive bears set upon by three or four dogs at a time for the entertainment of local villagers. The species is generally rather silent though a ten month old captive bear emitted a sort of whining hum when it was frightened or agitated. Feeding adults have been described as emitting puffing and bubbling sounds (Pocock, 1941). The sense of smell of this bear is acutely developed and is largely relied upon in detecting food or danger. Their eyesight is considered to be rather weak. If they encounter a human or any suspicious object they generally approach closer in order to pick up and identify the scent not relying much upon their eyesight. This is in fact a common attribute of all bears, which if encountered by an unarmed person can easily be put to flight if the human intruder circles cautiously around them until his scent is carried to them (G. B. Schaller, pers. comm.). Black Bears can swim well and there are several accounts of individuals having swum two or three miles across to islands (Beresford, 1944). A captive specimen has lived up to 27 years (Dover, 1932).

#### FAMILY MUSTELIDAE – WEASELS, MARTENS, BADGERS, POLECATS, SKUNKS, OTTERS

The Mustelidae comprises Weasels, Martens, Badgers and Polecats, and is a much less homogenous family than the Canidae or Felidae and more difficult to characterize. Earlier taxonomists subdivided the family into a bewildering number of sub-families, genera and subgenera. Recent studies subdivide the family into 25 genera (Walker et al., 1964) with about 75 different species.

Though varying widely in fur colouring, size and general shape most *Mustelidae* have long cylindrical bodies with relatively short powerful limbs. They are not deep chested like the *Canidae* and the first digit on the forefoot is well developed being usually in contact with the ground in contrast to the *Canidae*. The claws are non-retractile in most species and many of them can climb well and are extremely swift and agile in pursuit of their prey. The males have a well developed baculum (*os penis*). Both sexes have scent glands in the anal region.

#### Key to the Family MUSTELIDAE

Five digits on hind feet with claws non-retractile. Skull sturdy with short frontal region (see Fig. 41). Second upper molar absent. Body long and sinuous. Well developed anal scent glands present.

#### SUBFAMILY MUSTELINAE – MARTENS

Adapted to terrestrial or partly arboreal life. Body not markedly elongated and ears comparatively large.

#### Genus MARTES Pinel, 1792

#### Key to the Genus MARTES

Tail thick and bushy but variable in length. Rather pointed ears set wide apart on crown and visible in lateral silhouette. Hind foot over 65mm.

#### Key to the Pakistan Species of MARTES

- (a) Body fur dark reddish-chestnut. Head and body length 40–45cm with tail roughly half as long.  
... *Martes foina*.
- (b) Fur black on top of head, neck, outer limbs and tail. Sides of neck bright creamy-yellow, sharply contrasting with upper neck. Head and body length 40–63cm with tail nearly equal in length.  
... *Martes flavigula*.

#### MARTES FOINA

*Martes foina* Erxleben, 1777; Beech Marten or Stone Marten (see Illustration 25).

**Description:** This little animal has a dense soft fur of a rich liver-chestnut hue. Its head is broad between the ears which are low set and rounded. It has a sharp pointed muzzle and a bright alert appearance. The rhinarium is naked and pinkish-brown (see Fig. 39) and the iridaes are almost black in colour. The fore limbs are short and powerful and its body is long and lithe with a thick bushy tail generally about one half the length of the head and body. There are five digits on both fore and hind feet and the dark brown claws are non-retractile (see Fig. 39). There is no dark tip to the tail and the belly fur is pinkish-chestnut in colour, not being markedly paler than the rest of the body. There are two roughly parallel creamy-white lines extending from the chin down to the upper throat. This pattern is sometimes broken up into irregular spots or the lines fuse into a continuous white throat patch. There is considerable variation in this throat pattern between individuals (Gunther and Niethammer, 1967). Males are generally slightly bigger than females and



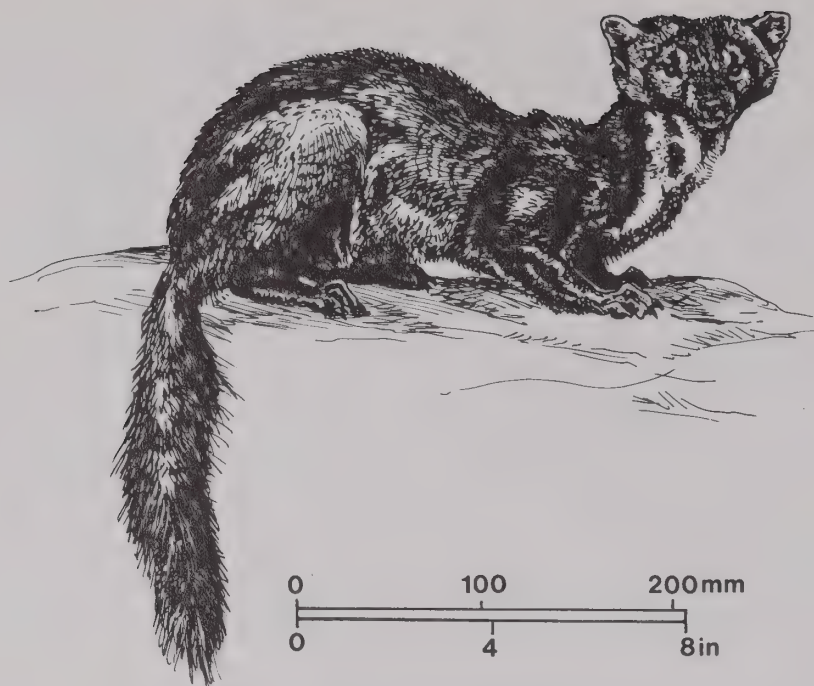


Illustration 25 *Martes foina*: Beech Marten or Stone Marten.  
(Based on photographs, free wild specimen, Mastung, Baluchistan.)

weigh about 1814g (4lb) standing about 12cm (4 $\frac{3}{4}$ in.) high at the shoulders. Pakistan specimens measure from 30–45cm (12–18in.) head and body length with the tail varying from 22–26cm. (8 $\frac{1}{4}$ –10 $\frac{1}{4}$ in.).

In winter coat there is a dense pinkish-buff under-wool and the guard hairs are generally tipped dark chestnut with a high gloss. There is some individual variation and I have seen a very pale sandy-coloured skin from Chitral as well as very dark brown skins from Baluchistan. Both colour variations can occur in the same region and there do not seem to be any population differences.

**Distribution and Status:** In Pakistan this marten is associated with mountain steppe country in regions of higher elevations where the winters are severely cold. Typically it is found in barren mountainous terrain in association with Wormwood (*Artemisia scoparia* and *Artemisia maritima*) scrub. In summer it may be found as high as 3600m (12,000ft) but in winter it often descends to cultivated valleys as low as 1200m (4000ft).

The Stone Marten is found throughout the main mountain ranges of Baluchistan including Kalat and Kharan. It extends sparsely throughout the remoter mountain regions of the North West Frontier Province and is more common in Chitral, Dir and Swat Kohistan. It also occurs in the northern regions of Hazara District, throughout Gilgit and in Baltistan and seems to be fairly plentiful in all these regions.

Extra-liminally this marten extends from the dryer regions of western Europe into Russia, Iran, Afghanistan, Tibet and Manchuria. It also spreads across the northern Himalayas eastwards to Sikkim.

In Baluchistan this marten is allopatric with the Marbled Pole Cat (*Vormela peregusna*) which latter occupies the valleys and lower mountain slopes where the marten rarely descends. In the Himalayas it generally avoids heavy forest and therefore does not overlap much in range with the Yellow Throated Marten (*Martes flavigula*). In Baltistan

and parts of Gilgit its habitat does overlap with the Altai Weasel (*Mustela altaica*) and the Stoat (*Mustela erminea*).

Constantly trapped for its valuable pelt, it is surprising that this marten has been able to survive over such a wide-spread area and this must largely be due to its ability to adapt to a wide variety of habitats, and to remain at higher elevations sparsely inhabited by man.

**Biology:** Martens are largely diurnal in hunting activity and may be seen abroad at any time of the day. They will, however, hunt at night in the vicinity of villages or farm



*Martes foina*

Distribution Map 44 Beech or Stone Marten.

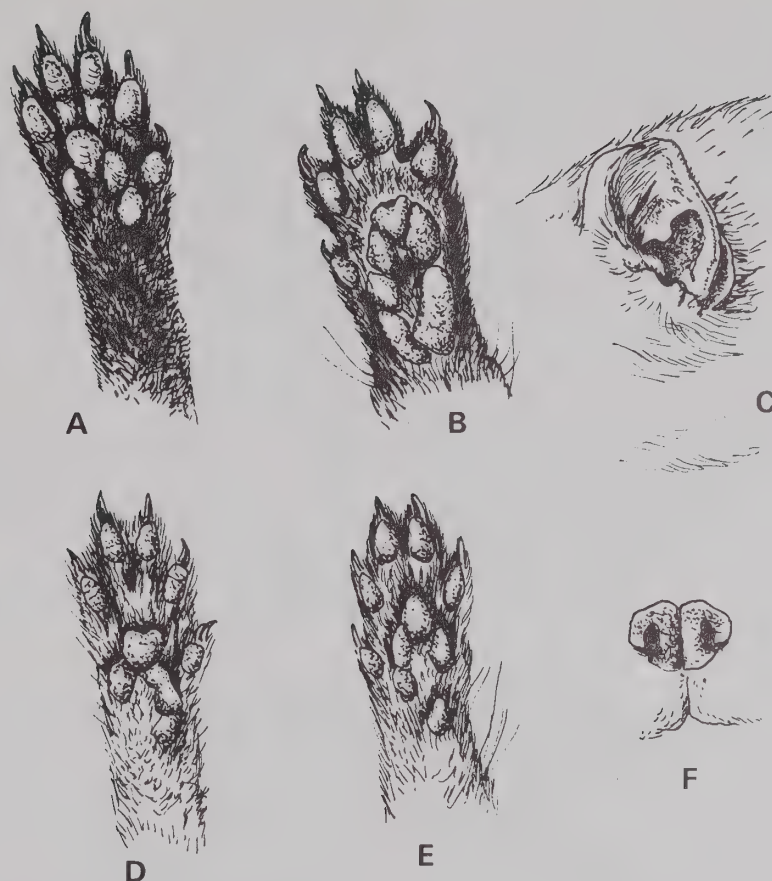


Fig. 39 Showing soles of feet and other details of *Martes* species.

A. *Martes flavigula*. Right hind foot.  
B. Left fore-foot of same.

C. Left side ear pinna of *Martes flavigula*.  
D. Right hind foot *Martes foina*.  
E. Left fore-foot of same.  
F. Rhinarium of *Martes foina*.

dwelling. Generally individuals are solitary but the young stay with their mother while learning to hunt until they are approximately three to four months of age.

The marten is capable of tackling prey heavier than itself such as domestic fowls and Cape Hares (*Lepus capensis*). It also preys upon Pikas (*Ochotona* spp.) and Rock Partridges or Chukor (*Alectoris graeca*), and various rodents such as Migratory Hamsters (*Cricetulus migratorius*) and Persian Jirds (*Meriones persicus*). They are known to be very fond of fruit, especially ripe apricots in Gilgit and Chitral. They can almost certainly detect fruit by smell, since a marten was found to enter a building in which apples were stored in late autumn in order to feed upon them (anonymous caretaker, Ziarat, pers. comm.), and I recall a similar incident when the closely related *Martes americana* entered a pick-up truck in British Columbia and was observed making off with an apple. Harrison (1964) records martens in Arabia eating locusts and Prater (1965) states that they will prey on lizards and frogs. In the winter, Stone Martens in Hazara District are successfully trapped by local villagers using wheat or maize meal as bait.

The Stone Marten is generally considered to be much less arboreal in hunting than *Martes flavigula* but it can climb trees with speed and agility as I can testify from direct observations of an individual which was feeding upon the ripe fruit of Russian Olive (*Eleagnus hortensis*). Like most carnivores living in high mountainous regions it is particularly fond of sunning itself on some exposed ledge during the day. Harrison (1964) records a captive specimen which enjoyed swimming

and bathing. Martens make use of natural rock crevices and caves for their shelter as well as hollows in trees but they will excavate or enlarge the burrow of some smaller mammal for their shelter and one such burrow in a colony of Libyan Jirds (*Meriones libycus*) was located under the roots of a *Tamarix* bush at Mastung in Kalat. They do not hibernate and remain active throughout the winter seeming to require less shelter than the Marbled Pole Cat.

Prater (1965) states that mating takes place in February with a gestation period of nine weeks. He does not indicate the evidence for this statement which is at variance with the gestation period of the closely related Pine Marten (*Martes martes*) which latter has 280 days gestation period with delayed implantation of the ova (Landowski, 1961). It is characteristic of the Genus *Martes* as a whole that mating takes place in the late summer with delayed implantation of the ova. Captive Pine Martens (*M. martes*) do not breed until the female is three years of age and mating seems to occur always in June, the female being in oestrus for about ten days (Hurrell, 1968). In Baluchistan there is some evidence that young are born in the early spring and that litters of two or three are the usual size. Two young martens which were about three-quarters grown were captured in the Chiltan Hills in early September when they were estimated to be between four and five months old. The young are blind, naked and very helpless at birth in contrast to the young of the Canidae which are well furred and relatively stronger. It is believed that martens live five to ten years in the wild.

Like others of this family the Stone Marten has quite a



repertoire of vocalizations. When suspicious or excited it makes a growling noise. When cornered or attacked they will emit loud screams. They also have a soft quickly repeated call which has been vocalized as 'tock-tock-tock' (Harrison, 1964).

Subgenus CHARRONIA Gray, 1865

MARTES FLAVIGULA

*Martes flavigula* Boddaert, 1785; Yellow-throated Marten (formerly known as White-checked Marten) (see Illustration 26).

**Description:** Considerably bigger than the Stone Marten it also has a conspicuously long tail and comparatively longer limbs than most other members of the genus. In general appearance this handsome marten is silvery blond over the lower flanks and hind quarters with the upper part of the face, neck, fore limbs and tail being almost jet black. The whole of the chest, throat, lower jaw and sides of the neck are creamy white deepening to a rich canary yellow colour on the sides of the neck. This yellow area contrasts sharply with the black fur on the upper part of the neck. The lower flanks and hind quarters contain a mixture of darker grey and brown hairs and there are a few reddish-brown guard hairs mixed with the darker parts of the body. The ears are low-set and rounded, their tips being level with the broad flat skull when the animal is viewed from front. There are naked pads to the fore and hind feet (see Fig. 39) with very sharp claws which assist the marten in climbing. The

rhinarium is naked and black and the iris dark brown. The fore limbs are tremendously muscular and powerful enabling this marten to run both underneath and along inclined branches as well as directly down vertical tree trunks, feats which rival even those of some monkeys. The tail is not bushy or graduated and its considerable length is no doubt a valuable adaptation as a balancing organ. Both sexes have two scent glands near the anus and at the base of the tail. The smell emitted by these glands is not so unpleasant as in other related genera such as *Mustela* although most humans would regard it as nauseous if inhaled deeply. The females have four mammae, one pair being rather far back in the inguinal region.

An adult female from Dunga Gali measured 635mm (25in.), head and body length with the tail 482mm (19in.) hind foot 103mm (4in.) and the ear 35mm (1.35in.). It weighed 3.4kg (7½lb). These dimensions are slightly above the maximum given by Prater (1965) for the Indian Himalayan population indicating that the population in the colder north west probably averages larger in size (Roberts, 1970). J. Harrison (1966) describes Malaysian specimens as averaging 40–55cm (16–21½in.) head and body length with the tail 32–45cm (12½–18in.).

**Distribution and Status:** Though a forest dwelling species *M. flavigula* is widely adaptable. Typically associated in the outer Himalayan ranges with the Silver Fir (*Abies pindrow*) and Blue Pine (*Pinus excelsa*) it also occurs in the tropical pine forest (*Pinus roxburghii*) and even descends to tropical deciduous forest and wild olive scrub forest in the outer foothills. To the north it has extended its range into dry temperate

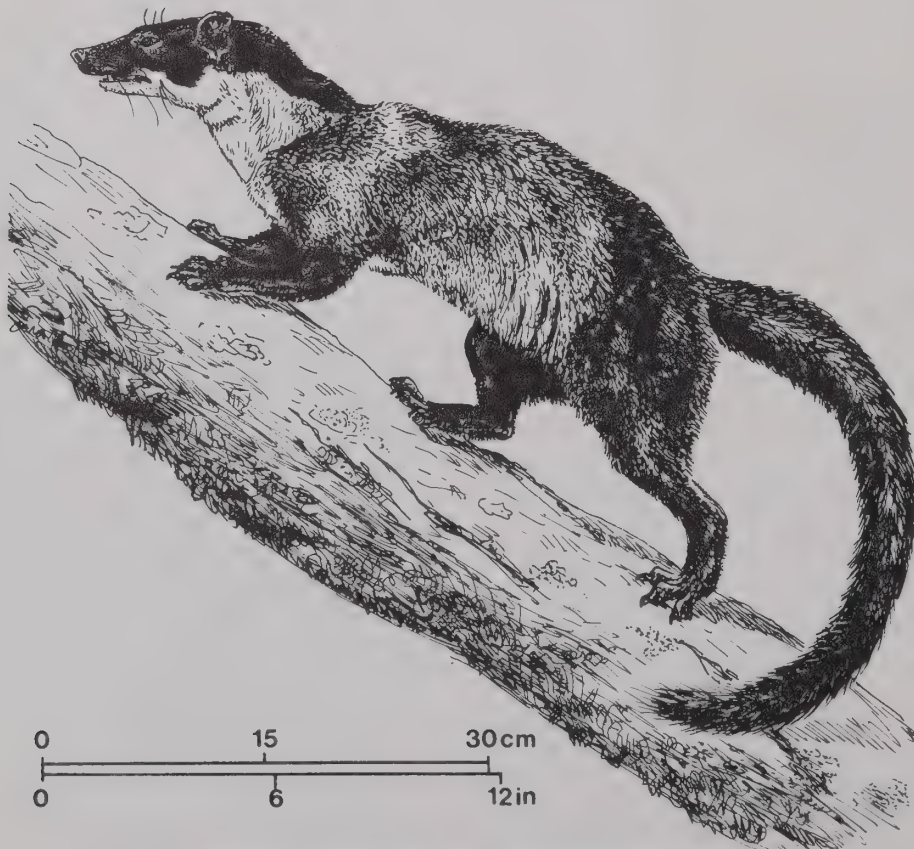


Illustration 26 *Martes flavigula*: Yellow-throated Marten.  
(Based on fresh killed adult female specimen from  
Dunga Gali, Murree Hills.)



*Martes flavigula*

Distribution Map 45 Yellow-throated Marten (formerly known as White-cheeked Marten).

Himalayan forest in association with *Cedrus deodara* and *Quercus balut*. It has not spread into the dryer treeless regions of the inner Himalayas nor southwards into the North West Frontier Province and Baluchistan. It is still fairly plentiful in the forests of Azad Kashmir and Hazara. It is rarer further west though it does occur in the lower part of Chitral and Dir. It is not uncommon in Swat Kohistan and also occurs in Chilas District of Gilgit. There are no definite records of its occurrence in Baltistan. It occurs in the Murree Hills extending down to the Marghala Hills and Lehtar. In the Safed Koh Hills of the upper Kurram Valley it still occurred in the late 1960s though it was considered rare. Southwards a very few still survive in the Kala Chitta Hills south of Campbellpur as well as small colonies in the Masan Valley and on Sakesar in the south west portion of the Salt Range. In these regions it lives in natural caves or under rocks, there being few trees large enough to afford adequate hollows. In the Government Gazetteer published in 1920 for the northern Punjab it was recorded as occurring at Choa Saidan Shah as well as at Rohtas. There is no recent evidence whether they still survive in these two places.

Outside of Pakistan it occurs very sparsely in north east Afghanistan and occasionally skins reach the fur traders of Kabul (J. Niethammer, in lit.). In the USSR it only occurs in the extreme south east of Siberia bordering China (Bobrinski et al., 1965), and its principal distribution is in the warmer tropical forests of south east Asia. It extends right across the Himalayas to Nepal and Sikkim through Assam, Burma, Malaysia, Indo-China and also Manchuria and Korea. A closely related species *Martes gwatkinsi* is found in south India in the Nilgiri Hills.

Although its fur is not highly valued by the trade it is constantly shot and trapped and has disappeared from many of its former haunts in the Murree Hills and the lower part of the Kaghan Valley. I have seen as many as 20 skins of this species with one trader in Peshawar and it is apparent that this beautiful species needs protection if it is to continue to survive in Pakistan where natural forest habitat is in any case of limited extent.

**Biology:** This marten generally lives a solitary life except for the female with growing young which remain in a family group for three or four months. They are partly diurnal in activity though they will hunt at night when close to human habitation. In undisturbed conditions they are mainly active during the day. Like all the genus they are both inquisitive and bold animals using acutely developed smell, hearing and vision to explore holes in trees and likely hiding places on the forest floor for their prey.

They are partly frugivorous and insectivorous and will kill and eat any small bird or mammal which they can overcome. A partially grown male killed in August in Dunga Gali had its stomach full of the nymphs of *Cicadas* which emerge at the onset of the monsoon. Another adult male was killed by a local farmer near Malach village in the act of feeding on his ripe apricots (*Prunus armeniaca*). I have watched a family party of a female with three half grown youngsters climbing over bushes of *Viburnum nervosum* to feed on the ripe berries in mid July. The Yellow Throated Marten is said by local hill people to be passionately fond of honey and the larvae of wild bees. I observed one entering a hollow high up in a plane tree which was occupied by nesting bees (Roberts, 1970). Undoubtedly this marten preys upon the two local species of Flying Squirrel which occur in the moist temperate coniferous forest (*Petaurista petaurista* and *Hylopetes fimbriatus*). R. I. Pocock (1941) records that in India this marten has occasionally killed and eaten young deer.

When encountered on the ground this marten seems relatively clumsy and noisy. Its presence in the forest undergrowth has often been betrayed to me by the agitated calls and mobbing flights of birds. I. R. Grimwood (in lit.) recalls hearing its approaching footfalls in the dry undergrowth over 94m (100yd) away in the Kulu Valley. However when traversing through the trees their speed and agility is truly astonishing. I have seen an individual leap at least 1m horizontally between branches of adjoining trees.

Litters are produced in the spring or early summer, two to three young being usual, though Prater (1965) records litters of five young. A female killed in late March contained two foetuses. A den was discovered in late July near Dunga Gali with a litter of three young which were then estimated to be nearly three months of age. There is some evidence that mating occurs in the late summer and that there is delayed implantation of the fertilized ova. Two adults engaged in a very excited chase which appeared to be courtship chasing were observed in August in the Murree Hills. On another occasion two adults were also observed together in Swat Kohistan in early August but no sexual behaviour was observed. Dr. Schaller (in lit.) has however seen two adults together in December in Chitral. Other marten species have a gestation period of up to 220 days which would indicate that if the Yellow-throated Marten mate in August, young are born in April, which coincides with the apparent time of parturition of this species in Pakistan.

The young martens referred to above had their den in a large hollow Yew Tree (*Taxus baccata*). The three young were extremely playful, chewing each others ears and tumbling about in fights. They were fond of sunning themselves together on a platform created by the top of an aged tree stump nearby. This family party was observed foraging with their mother as late as the latter part of August but it is not known how long they stayed with her. This den was located on a very steep and secluded slope about one furlong from a much frequented footpath. As with all the *Mustelinidae* the male takes no part in rearing the family.

Yellow-throated Martens make a variety of noises includ-



ing a low chuckling call as well as a staccato almost clicking sound. Adults regularly mark their territory by rubbing their scent glands on conspicuous stones or plants which trait is probably of value in a creature which is normally solitary in its hunting.

It is noteworthy that even in mid winter this marten does not develop a thick undercoat such as the Stone Marten does, at least in specimens collected from the Murree Hills. Perhaps this is because it is able to utilize much warmer shelters inside hollow trees.

### Genus *MUSTELA* Linnaeus, 1758

#### Key to the Genus *MUSTELA*

Ears round and do not protrude above crown in lateral silhouette. Body cylindrical, elongated sinuous. Hind foot under 65mm.

#### Key to the Pakistan Species of *MUSTELA* (See Fig. 40)

- (a) Tip of tail black. Throat and belly uniform creamy-white colour. Head and body length 17cm.  
... *Mustela erminea*.
- (b) Tail without black tip. Upper breast and throat dark creamy-yellow. Head and body length 24cm.  
... *Mustela altaica*.

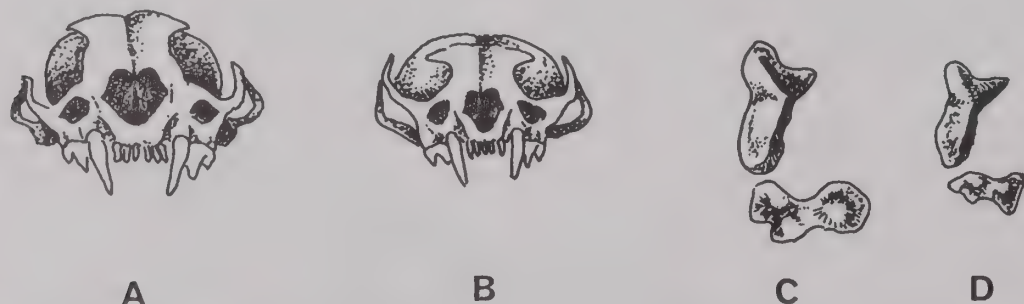


Fig. 40 Showing front view of skulls of *Mustela* species.

- A. *Mustela altaica*.
- B. *Mustela erminea*.

- C. Right side maxillary carnassial and first molar teeth of *Mustela altaica*.
- D. Same view of *Mustela erminea* teeth.

### *MUSTELA* *ERMINEA*

*Mustela erminea* Linnaeus, 1758; Stoat or Ermine (Short-tailed Weasel in North America) (see Illustration 27).

**Description:** All members of the genus *Mustela* can be distinguished from the martens by their comparatively smaller size with shorter legs and longer body. The stoat occurs throughout the northern hemisphere and its appearance is fairly well known. A small animal, being about 130g (4½oz) in weight, it has a long cylindrical body with a very long neck and short limbs. The head bears a rather blunt obtuse muzzle (see Fig. 41) with a naked black rhinarium and dark almost black eyes. The rounded ears are well covered with hair on both inner and outer surfaces. Both fore and hind feet bear five digits armed with sharp claws which assist the animal in digging. In winter only the distal toe pads of the feet remain naked and exposed, the planter pads being covered with fur.

The overall body colour is chestnut brown, usually of a rather dark reddish hue in Pakistan specimens. The chin,

throat and belly are creamy white. The slender rounded tail is not particularly bushy and has a conspicuous tip of black hairs. The guard hairs are highly glossy like that of most *Mustelinidae*. In autumn the Pakistan population moults into a creamy-white coat covering the entire body except the black tail tip. This glossy white fur has always been prized for human adornment, and as is well known, white ermine was by tradition reserved for royalty in Medieval Britain. In Pakistan the moult into winter coat probably takes place rather gradually from October up to December and often traces of cinnamon brown tipped hairs remain. It has been shown in the Arctic Hare (*Lepus timidus*) as well as Ptarmigan (*Lagopus mutus*) that this moulting process into an all white colour is triggered off by changing lengths of daylight and can be artificially induced out of season. It is difficult to understand the value of such a change in a species like the Stoat, which is a bold predator and makes no effort at concealment. Furthermore the stoat has few natural enemies and its principal winter food is hunted underground where white colouration gives no help in concealing it. It is not known whether all stoats in Pakistan assume a white coat in winter but R. I. Pocock (1941) refers to three white specimens, two of which were collected in Chitral and one in the Safed Koh Range. The latter, collected in February had a few scattered brown spots on the nape and shoulders whilst a specimen collected in March from Chitral was still pure white.

Pakistan specimens appear to average smaller than those

from other parts of the world. Head and body length varies from 18.4–22.9cm (7¼–9in.) with the tail from 70–89mm (2¾–3½in.) in length.

**Distribution and Status:** Judging from the records of specimens collected in Pakistan the stoat is mainly associated with alpine and sub-alpine scrub zones in the Himalayas. It seems to be absent from forested country but may wander in winter down to dryer valley regions in the extreme north west of Pakistan, since Major Wall (1910) collected a specimen at 1500m (5000ft) in the main Chitral Valley. It appears to have invaded the region from the northern pale-arctic regions as it has not extended its range south of the Safed Koh Mountains.

The first record of its occurrence in the Indo-Pakistan sub-continent was a specimen collected in the Kaghan Valley by Captain Whitehead in 1907 (Wroughton, 1908). It has since been found to be fairly plentiful in the Kaghan Valley and also in lower Chitral and northern Swat in alpine meadows. In Chitral it was collected in the Laspur and



Illustration 27 *Mustela erminea*: Stoat or Ermine. (Based on study specimens in British Museum collection from Kaghan Valley, Hazara District.)



Fig. 41 Dorsal view of skulls of three different families of *Carnivora* drawn approximately to scale.  
A. *Mustela erminea*.  
B. *Felis libyca*.

C. *Paguma larvata*.  
Note the greatly shortened muzzle in the skull of the Desert Cat and the comparatively large and well developed cranial area in all three families.



Yarkhum valleys. In the Kaghan valley specimens have been collected as high as 4000m (13,000ft). It does not occur in the Murree Hills and there are no records as yet of its occurrence in Gilgit or Baltistan. However it has been collected in Ladakh, in India and from the Pir Panjal Mountain range close to Azad Kashmir and the stoat probably occurs throughout Gilgit in suitable alpine regions where its food prey is abundant.



Distribution Map 46 Stoat or Ermine.

In India the stoat has been recorded usually above 3600m (12,000ft) and only in Kashmir but not further east in the Himalayas. It has not been recorded in Iran. It is widespread throughout Russia and northern Europe, inhabiting a variety of biotopes from rich farm land at sea level up to the arctic tundra. It is apparently unable to adapt to sub-tropical or very arid conditions.

Its ability to survive at high altitudes even in winter, probably enables the stoat to largely escape the attention of local hunters. Its skin appears to be spurned by Pakistan fur traders since its pelt rarely is displayed in their stocks. The stoat will probably continue to be fairly numerous in the restricted localities of Pakistan where it occurs.

**Biology:** Despite its diminutive size the stoat is more exclusively carnivorous than martens, living mainly on rodents. In Europe the stoat is noted for its relative strength and courage in tackling prey much bigger than itself. However, in Pakistan it preys almost exclusively on High Altitude Voles (*Alticola roylei* and *Hyperacrius fertilis*). It probably also attacks Royle's Pika (*Ochotona roylei*) and any birds which it can surprise and overcome. In summer it may also vary its diet with birds' eggs and even insects.

It is normally solitary in hunting, occupying burrows already dug by rodents and because of its small size often pursuing voles in their underground tunnels. Stoats hunt both by day and night and have been observed in the Kaghan valley in the middle of the day, scampering between the rocks close to a mountain trail. In winter, deep snow blankets the alpine

slopes where this stoat lives but the voles continue to feed and construct an elaborate labyrinth of tunnels beneath the surface of the snow so that it is presumed that the stoat continues to prey upon them. In Russia it has been observed that the stoat occasionally kills four or five voles and stores them underground for future consumption (Ognev, 1935). This interesting trait is also shared by other Mustelinids (see account of *Vormela peregusna*).

It is presumed that the breeding biology of the stoat population living in the high Himalayas differs little from that in other parts of the world where this species has been closely studied. Breeding takes place during the summer but the ova are not implanted in the wall of the uterus until some four weeks before the young are born which is some time in the spring. The stoat only produces one litter a year unlike the Weasel (*Mustela nivalis*). Litter sizes range from five to ten, with as many as thirteen young having been recorded in Russia (Ognev, 1935). The mother constructs a nest-chamber by enlarging a deep underground burrow and lines this chamber with dry grass and the fur of voles. There may be two or more entrance tunnels leading to this chamber. The babies are born blind and nearly helpless but they develop rapidly and are weaned at about five weeks of age.

In Pakistan the stoat is sympatric with the Hill Fox (*V. v. griffithi*) and the Stone Marten (*Martes foina*). Apart from these larger predators the stoat has few natural enemies, though larger birds of prey will eat stoats if they have the opportunity (Corbet, 1966). In Europe, stoats have been observed swimming strongly as well as climbing trees. When cornered or threatened the stoat will emit a high pitched chattering.

## MUSTELA ALTAICA

*Mustela altaica* Pallas, 1811; Alpine Weasel or Pale Weasel. Altai Weasel in the USSR. Formerly called White-footed Weasel in India (see Illustration 28).

**Taxonomy:** The Altai Weasel is closely similar to the Yellow-bellied Weasel, (*Mustela kathiah*) in size and appearance and there has consequently been some confusion in the earlier identification of Himalayan specimens, as revealed by the series of skins in the British Museum collection. *Mustela kathiah* is probably allopatric with *Mustela altaica*, the former being an inhabitant of much more humid forest regions in the eastern part of the Himalayas. If a large series of specimens can be compared, *M. kathiah* can be readily separated by its much darker mahogany dorsal fur and deep creamy yellow belly fur. Because some individuals of *M. altaica* have bright yellow fur in the throat and ventral region they have been wrongly identified as Yellow-bellied Weasels. A specimen collected near the Baltoro Glacier in Baltistan was referred to as a new subspecies of *M. kathiah* by DeBeaux (Pocock, 1941), but this was in fact *M. Altaica*.

**Description:** This is a typical weasel with a long cylindrical body, short legs and the narrow flattened skull (see Fig. 40) with rather obtuse muzzle characteristic of all members of this genus. It also has the same low set rounded ears and sinuous snaky body with long neck. The Pakistan population is considerably larger in size than specimens of *Mustela erminea*. The throat and ventrum is distinctly creamy-yellow in colour and in specimens from Baltistan the thoracic region is a bright canary yellow. Specimens from Hazara District had the ventrum pale primrose yellow whereas the throat and upper breast were more creamy-white. The tail which is

cylindrical and not bushy is comparatively longer in this species than in the stoat and lacks any black tip. Pocock (1941) described typical specimens as having the upper part of the foot whitish, and gave it the English name Pale-footed Weasel. However none of the specimens from Pakistan region in the British Museum and Smithsonian collections have feet so marked.

Three specimens from Pakistan had the head and body length averaging 256mm (10in.) (varying from 227–276mm (8.9–10.75in.)), the tail averaging 138mm (5.4in.) (varying from 118–155mm (4.65–6.15in.)) with the hind foot averaging 45mm (1.75in.) (varying from 38–50mm (1.5–1.98in.)) and the ear 21mm (0.8in.) (varying from 17–25mm (0.65–1in.)). Pocock (1941) gives the measurements of nine specimens collected outside Pakistan limits which had an average head and body length of 243mm (9.6in.) with the tail average 159mm (6¼in.). A specimen captured from Lahul (India) weighed 127g (4.4oz).

**Distribution and Status:** In Pakistan the Pale Weasel is confined to very high mountainous regions in the alpine zone in the southern part of its range or further north in mountain steppe country in regions of very scanty rainfall. It occurs in a wide variety of habitats from the broader valleys at 1500m (5000ft) elevation often in almost desert conditions as well as in more humid alpine slopes up to 5200m (17,000ft) as well as in dry coniferous forest between 2450–3000m (8–10,000ft). Specimens have been collected in Baltistan near the Indus Valley at Parkuta Village at 1500m (5000ft) (Z. B. Mirza, pers. comm.) as well as at Gilgit and in the northern part of the Kaghan Valley at Gitidas at 3600m (11,800ft) elevation and Saiful Maluk at 3200m (10,500ft). There are



Mustela altaica  
Distribution Map 47 Alpine or Pale Weasel — known as Altai Weasel in the USSR.

no records of its occurrence in Chitral or Swat Kohistan. In India it occurs throughout the northern or inner ranges of the Himalayas from the upper Sutlej Valley to Sikkim. It also occurs in Tibet and Ladakh, extending eastwards to outer Mongolia and south western China. It does not appear to have been recorded in Afghanistan (Hassinger, 1968) and in

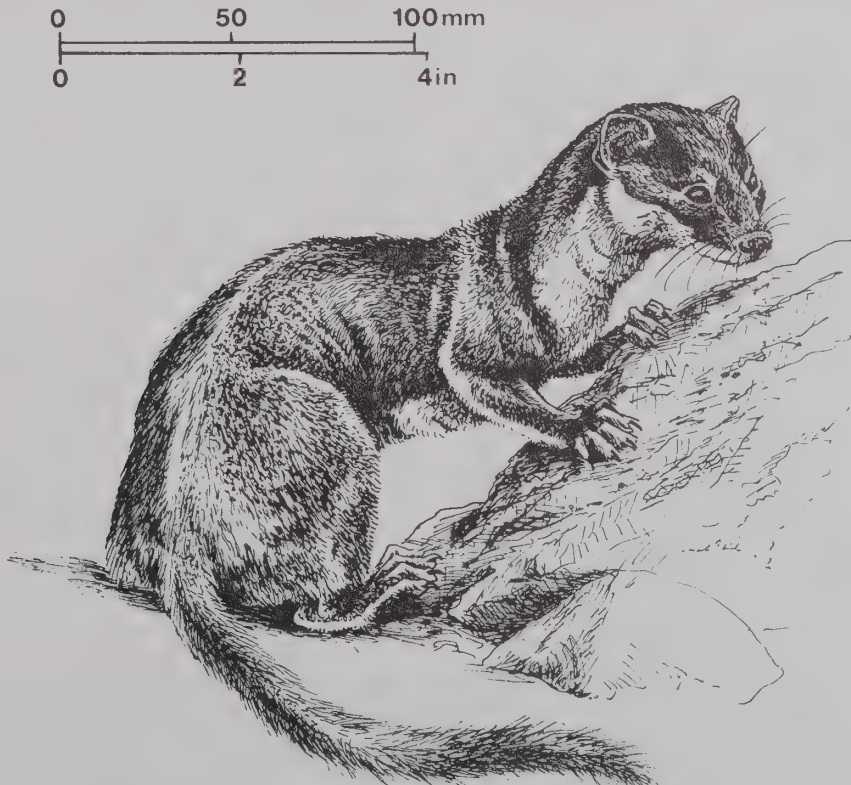


Illustration 28 *Mustela altaica*: Alpine Weasel or Altai Weasel. (Based on photographs of fresh killed specimen in possession of Z. B. Mirza, and study specimen in Punjab University collection, adult male from near Skardu, Baltistan.)



Russia it is widespread through the southern part of Siberia from the Ussuri region extending south westwards to Turkestan (Bobrinskii et al., 1965).

It would appear to be relatively rare in Pakistan except possibly in Baltistan.

**Biology:** Very little has been recorded about the habits of this weasel. It is known to be a bold and inquisitive hunter like others of its genus, and capable of tackling prey much bigger than itself. It is believed to be almost exclusively carnivorous, preying mainly upon Pikas (*Ochotona roylei*), Migratory Hamsters (*Cricetulus migratorius*) and Voles of the Genus *Alticola*. Possibly, in summer they can supplement their diet with lizards which are plentiful in these northern mountainous regions frequented by this weasel. There are no records of it eating any fruit.

The snowfall is generally lighter in the regions of Pakistan inhabited by the Altai Weasel but temperatures drop well below 0°F during the coldest part of winter and the Altai Weasel, which does not hibernate must shelter in fairly deep underground burrows at this season. Probably they are capable of excavating their own burrows.

Pocock (1941) records that the Russian population, found in the Altai Mountains mates in February, producing its young in May and that the litter size does not exceed five in number. Females have four pairs of mammae and a specimen collected from Lahul in September was still lactating (Pocock, 1941). There appears to be no evidence of delayed implantation of the fertilized ova in the Russian population of this weasel (Dr. Sokolov, Zoological Academy, Leningrad, in lit.).

#### Genus VORMELA<sup>1</sup> Blasius, 1884

This is a mono-typic genus of which the single species though closely related to the Pole Cats of the Genus *Mustela* is distinguished from the latter by having the lower carnassial pre-molar teeth with a distinct inner cusp, i.e. metaconid.

#### Key to the Pakistan Species of VORMELA

Upper part of body pelage mottled with dark brown and white. Tail very bushy and half of head and body length. Forehead with prominent white band. Lower carnassial teeth with small lingual cusp.

... *Vormela peregusna*

#### VORMELA PEREGUSNA

*Vormela peregusna* — Gldenstaedt, 1770; Marbled Pole Cat. Sarmantier in Russia (see Illustration 29).

**Description:** This beautiful little animal has a most striking appearance, its body being boldly patterned with irregular blotches of white and dark brown giving a marbled effect as suggested by its name. It is a perfect example of those small carnivorous animals which possess offensive scent glands and have a conspicuous warning colouration. The face mask is particularly striking with broad white bands running above and below the eyes as well as white hairs fringing the insides of the ears. Somewhat larger in size than a stoat but much smaller than the Stone Marten, it has a typical long sinuous body and short limbs. The ears, however, are more upstanding than those of a typical marten. The feet are armed with long and strong claws and no doubt assist the animal in digging. The tail is bushy with predom-

antly white hairs in its proximal portion and black or dark brown hairs in the distal one third. The body fur is highly glossy and of a dark reddish-chestnut verging almost to black over the shoulders, throat, chest and lower limbs. The front portion of the pointed muzzle as well as a broad band through the eyes is also dark brown. There is some individual variation with the white patches in the dorsal region varying from creamy-yellow on the lower flanks to pure white around the sides of the neck, insides of the ears and the muzzle.

A typical Baluchistan specimen had the head and body measuring 320mm (12.6in.), the tail 175mm (6.8in.) with the hind feet 43mm (1.7in.) and the ear 30mm (1.2in.) in length. Russian specimens are described as having the head and body varying from 270–350mm (10.6–13.75in.) in length with the tail varying from 120–180mm (4.68–7.02in.) (Flint et al., 1965). An adult captive male weighed 620g (22oz). Females are slightly smaller and lighter in build, and have five pairs of mammae.

The eyes are rather small in this polecat and the vibrissae are profuse and comparatively long. The tail tends to be laterally compressed with the hairs lying in a vertical plane and in this respect it is similar to that of the small Indian Civet. When threatened, the Marbled Pole Cat is capable of erecting the hairs on its tail which it arches over its back, thus creating an effect of greater size.

**Distribution and Status:** The Marbled Pole Cat is an inhabitant of semi-arid rocky areas preferring upland valleys and low hill ranges to higher mountain ranges. It is associated with steppe country as well as arid sub-tropical scrub forest. In Pakistan it occurs only in Baluchistan and the southern part of the North West Frontier Province in the valleys or at lower elevations. It extends from the Mekran in the south and occurs around Quetta, Pishin and Chaman. It seems to be less common in the higher mountainous country of north-east Baluchistan though it occurs in north Waziristan and specimens were brought to Major MacGrath (1909) when he was stationed at Bannu. It is found in the upper Kurram Valley where the local people considered it fairly common in the 1940s (Johnson, 1942). It was also collected at Hangu



*Vormela peregusna*

Distribution Map 48 ◻ Marbled Pole-cat or Sarmentier.

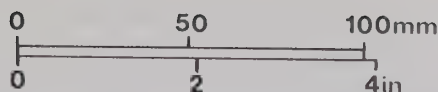


Illustration 29 *Vormela peregusna*: Marbled Pole-cat or Sarmantier. (Based on live captive specimen in possession of J. A. W. Anderson from Quetta, Baluchistan.)

in Kohat District (Donald, 1939). It does not seem to have extended its range further north and has not been recorded anywhere in the Himalayas. It occurs in southern Afghanistan where it appears to be rather uncommon (J. Niethammer, 1968, in lit. and J. Hassinger, 1968). It appears to be sparsely distributed in northern Iran (Lay, 1967). It occurs nowhere in India but spreads westwards through Turkey, Syria, The Lebanon, and into Yugoslavia. In Russia it extends throughout the steppe country from Trans-Caspia and the Caucasus eastwards to the Altai foothills (Flint et al., 1965).

The Marbled Pole Cat does not seem to be very common anywhere in Pakistan though a few skins come into the hands of Quetta fur traders each year. It would appear to be allopatric with the Stone Marten (*M. foina*) being absent from steppe forest regions and the higher mountain slopes which are frequented by the latter species. Because of its rather secretive and fossorial habits it does not often come into conflict with man and may actually be commoner than the present limited evidence reveals. It is undoubtedly beneficial to agriculture because of the rodents which it destroys.

**Biology:** Amongst all the Mustelinidae inhabiting this region of Asia, the Marbled Pole Cat is the most highly adapted to a fossorial existence. In Baluchistan they are particularly associated with colonies of Libyan Jirds (*Meriones libycus*) and even occupy the burrows made by these Jirds. The Marbled Pole Cat will however excavate its own burrows and captive specimens readily show this inclination to dig. Pocock (1941) records that a captive specimen used its teeth to tear out tough roots and to assist in excavating a burrow. In many parts of Baluchistan *V. peregusna* utilizes and inhabits

'kharezes', (underground irrigation tunnels). My own observations on three different captive specimens indicates that they are much more sluggish than most other Mustelinids and certainly spend a greater part of the time sleeping in their underground burrows. In cold weather, however, wild specimens will come to the surface in the middle of the day, in order to bask in the sun. Observations on captive specimens indicate that they rely principally upon an acutely developed sense of smell and that their eyesight is relatively weak. A wild pair, observed sunning themselves on a sandhill showed no reaction to human approach until a slight breeze apparently carried human scent to them when they at once disappeared. A tame specimen always burrowed into a loose piece of cloth before going to sleep (Yate, 1897) and I have also observed this strong desire to seek dark places in other captive specimens. Compared with other Mustelinids they show a marked reluctance to jump or climb even when released into a room. These characteristics seem to be associated with their fossorial existence but in other traits they seem typical Mustelinids. For example they are fearless in the presence of human beings and they are voracious hunters of their prey.

Besides Libyan Jirds, they prey on other rodents such as Migratory Hamsters (*Cricetulus migratorius*) and House-mice (*Mus musculus*) which frequent the same habitat. They are believed to be largely carnivorous in diet and have not been observed eating fruit or vegetable matter. Pocock (1941) recorded that a captive specimen ate beetles and lizards. Akhtar (1945) recorded that a captive specimen only relished raw meat, refusing frogs, toads, fish as well as cooked meat. This same specimen greedily ate small birds including all their feathers. Van den Brink (1964) states that they will make underground stores or larders of surplus killed prey. Akhtar



(1945) also recorded that his captive specimen took food which was surplus to its immediate needs down into its burrow to be stored. The very low humidity and relatively cool temperatures which must prevail in the burrows of this Polecat in Baluchistan, would certainly enable dead rodents to be preserved for several weeks without putrefaction. J. A. W. Anderson (pers. comm.) while excavating the burrow of a Libyan Jird near Quetta, found five dead specimens of *Meriones libycus* which had been killed by some sharp-toothed predator. They were piled together in an underground chamber and were almost certainly the larder of this polecat.

In Baluchistan most breeding appears to occur so that litters are born in the spring. A litter of three young excavated near Quetta were estimated to have been born about the end of March (Christison, 1939). In Kandahar (Afghanistan) they were reported to produce generally three to four young at the end of March or early April (Hutton, 1845). In Armenia (Russia) the Marbled Pole Cat has been recorded as breeding from April to May producing four to eight young in a litter after a gestation period of eight weeks (Ognev, 1935). Prater (1965) suggests that the gestation period is nine weeks and that March to April is the normal season of birth. A pair of wild Marbled Pole Cats in western Baluchistan were seen together in August.

The Marbled Pole Cat emits an offensive odour from its perineal glands when threatened, but first of all it arches its tail over its back with hairs erected so that the tail is almost the width of its body. It also bares its teeth in a defiant snarl. When excited they utter a shrill chattering cry. A captive specimen was described as being very playful and would chase a piece of paper tied to a string when it was in the mood (Yate, 1897).

#### SUBFAMILY MELLIVORINAE – RATELS

##### Genus *MELLIVORA*<sup>10</sup> Storr, 1780

This is a monotypic genus and though bearing a close resemblance to the Badgers of the Genus *Meles*, the Ratel is quite distinct in its dentition which is more highly adapted to a carnivorous diet.

#### Key to the Genus and Pakistan Species of *MELLIVORA*

External ear pinna reduced to a thickened ridge. Sub-caudal sac gland absent. Body thickset with short tail, coarse pelage and short limbs.

Whole of upper back, crown and neck uniformly greyish-white sharply contrasting with lower portion of flanks, legs and face which are black. Claws on fore limbs greatly elongated. Hind feet 120mm.

... *Mellivora capensis*.

#### *MELLIVORA CAPENSIS*

*Mellivora capensis* Schreber, 1776; Ratel or Honey Badger (see Illustration 30).

**Description:** The ratel is a thickset ugly animal of most striking appearance. Its coarse body fur is sharply divided horizontally in two contrasting colours. The top half of the head, upper neck and back is silvery-grey whilst the limbs, belly, lower cheeks and muzzle are jet black. The head is broad with a fairly short square muzzle and the external ear pinna are very small being reduced to mere leathery flaps hardly 10mm ( $\frac{3}{8}$  in.) long. This gives its head a rounded appearance

rather reminiscent of the South American Tree Sloth. The fore limbs are powerfully developed and bowed inwards like those of a bear. The five digits on the fore feet are armed with noticeably long powerful claws which measure up to 38mm ( $1\frac{1}{2}$  in.) in length and are blackish in colour. The claws on the hind feet are much shorter. The soles have naked pads and the ratel is plantigrade. The hair all over the body is distinctly coarse and rather sparse, lacking any underfur. The tail is rather short and tapered without being in any way bushy. A typical adult specimen stands about 25cm (10 in.) at the shoulders and measures 60–75cm ( $23\frac{3}{8}$ – $29\frac{1}{2}$  in.) from nose to tail tip. The tail measures from 15–24cm ( $6$ – $9\frac{1}{2}$  in.). Males are slightly heavier and an adult specimen may weigh up to 10kg (22lb).

Some individuals have a tawny or yellowish tinge to the hair in the region of the lower back and flanks and young animals in Africa are reported to be rusty-grey rather than silvery-white on the upper half (Dorst and Dandelot, 1970).

There is a sac-like gland around the anus from which an offensive secretion can be emitted.

**Distribution and Status:** In Pakistan this mammal is now extremely rare in the more densely populated tracts of the Indus Basin but it still occurs sparsely throughout the southern parts of Baluchistan as well as southern Sind extending northwards through the desert regions bordering upon India. It shuns high mountainous regions as well as northern cold latitudes and seems to frequent barren rocky hill country or desolate sand-dune regions, avoiding cultivated areas. There are records of its recent occurrence in the Mekran, Las Belas, Kalat and the Chagai. It also occurs very sparsely in Sibi, Pishin and Loralai districts of Baluchistan. It occurs throughout Sind Kohistan and extends eastwards through Thatta and Tharparkar Districts of Sind. They also occur in Cholistan. A specimen in the late 1960s frequented underground passageways in part of the old fort of Dharawar (Lt. Gen. J. H. Marden, pers. comm.). It has also been recorded in Waziristan but there seem to be no recent authentic records of its occurrence in the Punjab or anywhere in the northern mountainous regions.



*Mellivora capensis*

Distribution Map 49 ☞ Ratel or Honey Badger.

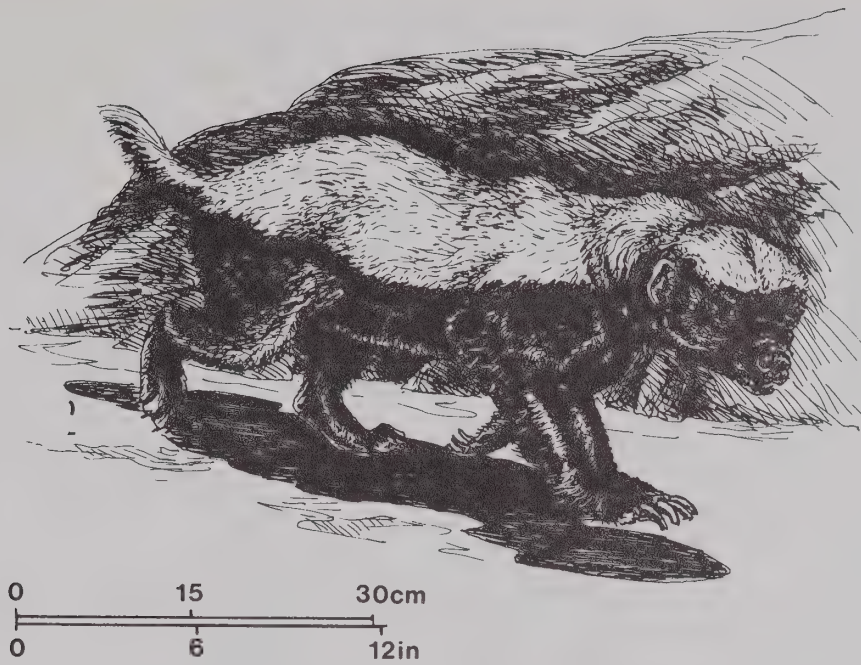


Illustration 30 *Mellivora capensis*: Ratel or Honey Badger.  
(Based on captive specimens in Bahawalpur and Lahore  
Zoos. Former from near Bahawalnagar, Bahawalpur  
Division.)

Extra-limitally the ratel occurs through most of Africa except for the Sahara. It is rare in Arabia but has been recorded in southern Afghanistan as well as Khuzistan in Iran (Lay, 1967). To the east it frequents the central and dryer parts of India but has not penetrated into the more humid regions of Assam or south east Asia. In Russia it occurs around the Turkmen Plains (Bobrinskii et al., 1965). The species appears to be of Ethiopian origin and to have invaded the Indo-Pakistan sub-continent through southern Baluchistan.

Today the ratel is very rare throughout Pakistan and restricted in distribution though it was relatively common in Sind up to the end of World War II (Eates, 1968).

Because of its rather strange appearance the ratel is surrounded by superstition. Besides having the reputation of digging up human corpses from graveyards, many local people in Sind believe that if they encounter a ratel at night when alone, that it will rear up on its hind legs and suffocate them with its breath (Eates, 1968). Consequently this relatively harmless animal is killed whenever encountered and even wardens in game reserves kill the animal on sight. It is beneficial to man, since it preys upon snakes and rodents, and so it is a pity that there is so much unjustified prejudice against it.

**Biology:** The ratel is not exclusively nocturnal in activity though most observers have recorded encountering it at night. J. A. W. Anderson (pers. comm.) encountered an individual in mid afternoon while motoring through Las Belas. It showed little fear of the human intruders. D. L. Harrison (1968) also encountered a pair in the Syrian desert in mid afternoon. They are often encountered in pairs which would seem to indicate that a lasting pair bond may be formed which is not typical of the majority of Mustelinidae.

They are capable of subsisting on a variety of foods though as their dentition suggests, their preferred diet is meat. Pocock (1941) refers to their ability to kill cobras (*Naja naja*)

for food. They are also known to eat any small rodent or birds which they can overcome as well as bird's eggs and insects (Blanford 1888). Ratels in Russia (Ognev, 1935) and Syria (Harrison, 1968) have been recorded as feeding on lizards. Like the African population they are fond of honey and will eat the larvae of wild bees also (Dunbar Brander 1931). A local hunter in Dadu District (Sind) pointed out excavations in the dry sandy bed of the Bara Nullah and claimed that these were made by the ratel in its search for a certain type of succulent root. It is noteworthy that Dunbar Brander (1931) records encountering them digging in the sandy bed of streams in central India also. Captive specimens can remain quite healthy on a completely vegetarian diet but I have not been able to obtain any direct evidence that roots are eaten by this species. They will consume the ripe fruit of the Ber (*Zizyphus jubata*) and several authors (Pocock 1941 and Prater, 1965) have confirmed that they are able to climb trees with agility despite their relatively clumsy build. A tame ratel in Russia could climb up a smooth telephone pole with ease (Ognev, 1935).

As already indicated, ratels are relatively fearless of humans and if in danger can emit an offensive secretion from their anal gland. Their black and white pelage may therefore be an example of nature's warning colouration since it is conspicuous even on moonless nights. Ratels are also endowed with tremendous strength relative to their size. In Sind a ratel when set upon by two large dogs of the hunting type, succeeded in warding off their attacks and eventually putting them both to flight (K. R. Eates, pers. comm.). Major Grimwood (in lit.) observed a captive ratel which bit its way to freedom through eight gauge wire netting in a short space of time. On another occasion in Kenya a ratel attacked and savaged the front tyres of a three ton lorry which was being driven in an attempt to intercept the animal (Grimwood, in lit.). As if its aggressive nature were not sufficient protection against enemies, many writers also record that the ratel has a very loose and thick skin, impervious to the quills of porcu-



piners, bee stings and even the biting of dogs (Dunbar Brander 1931, Pocock, 1941, and Prater, 1965).

Besides being able to climb trees they are quick and energetic excavators and Pocock (1941) records Hardwicke who saw a captive specimen digging itself completely under cover within ten minutes even on hard ground. Rats normally occupy burrow systems which they presumably excavate themselves or enlarge from those of other Mammals and these can frequently be under old ruined buildings or in graveyards which may partly account for their reputation as grave diggers. Much controversy raged in the 1930s and 1940s amongst naturalists as to whether the ratel was actually guilty of eating human corpses. Only one authentic instance was cited by Dunbar Brander (1931) and another authority who investigated many alleged incidences never came across any positive evidence of grave robbing (Champion, 1933). The Sindi name for this animal is 'gorpat' which means grave digger.

Ratels are playful when out foraging together. Several authors have noted their habit of suddenly turning a somersault. Major Grimwood (in lit.) watched a pair in Zambia sliding down a mud slide like otters at play. Their usual gait is a rather clumsy shuffling with the tail commonly cocked up over their backs.

The gestation period is believed to be 180 days and the usual litter size is two (Walker et al., 1964). They breed throughout the summer months and may produce two litters in a year (Prater, 1965). In Russia the mating season is from September to October with young appearing in April and May (Ognev, op. cit.).

Captive specimens have lived up to 23 years of age.

#### SUBFAMILY LUTRINAE – OTTERS

There are representatives of this subfamily throughout both hemispheres in tropical as well as holarctic regions. They are well adapted to a semi-aquatic existence and to hunting fish and Mollusca, with broad paddle shaped tail and thick fusiform body and a web of skin between all the digits of fore and hind feet.

#### Key to Subfamily LUTRINAE

Adapted to semi-aquatic life with head flattened, and tail thickly muscular proximally being over half the length of head and body. Pelage dense and smooth with paws comparatively large, and webbed between digits.

The subgenus *Lutra* (Brisson, 1762) has the distal portion

of tail elliptical in cross section with less flattened lateral keel. Upper margin of rhinarium indented in 'W' shape (see Fig. 42).

#### LUTRA LUTRA

*Lutra lutra* Linnaeus, 1758; Common Otter.

Subspecies *L. lutra kutab* chinz, 1844; Himalayan Otter.

**Description:** The Common Otter which extends to the rivers of western Europe is too familiar in appearance to need detailed description. It has very dense short fur of a dark olive brown colour dorsally which lightens to a silvery-brown on the throat and ventrum. The guard hairs are highly glossy which no doubt aids in quick drying as well as minimizing friction when swimming under water. The tail, which is usually just over half the head and body length, is very thick and muscular at the base and flattened dorso-ventrally into a paddle shape in its distal portion. A closer examination reveals that the ventral surface of the tail is rounded or convex so that the tail is elliptical in cross section (see *L. perspicillata*).

The external ear pinnae are very small and capable of being pressed back against the skull when under water. The head is flattened and broad with a naked black rhinarium. The upper margin of this nose pad is indented like a 'W', an important characteristic to distinguish this from *L. perspicillata* (see Fig. 42). There are a number of very stiff short white vibrissae around the muzzle which may assist the animal in searching under stones and in turbid water for its food prey. Both fore and hind limbs have five digits with broad elastic webs between each toe. The claws are very short, about 8mm (0.35in.) in length and somewhat blunt with soft broad naked pads at the tip of each digit. This, again, appears to be a valuable adaptation for feeling and grasping underwater prey.

There is some variation in body colouration with some individuals having paler silvery tips to the guard hairs in the dorsal region. There is no sharply defined dividing line between the darker dorsal and paler belly fur. Both sexes have a glandular pouch around the anus from which a secretion emanates but according to some authors the smell from this secretion is not particularly repellent (C. J. Harris, 1968). Himalayan specimens generally average smaller in size than European forms with the head and body varying from 60–76cm (24–30in.) in length and the tail from 35–46cm (14–18in.). Its weight varies from 5kg (11lb) in small females to

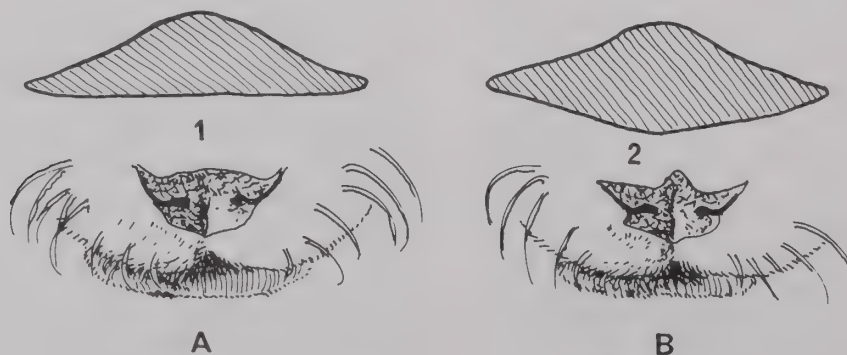


Fig. 42 Showing means of identification of otter species in Pakistan.

1. Diagrammatic cross-section through distal portion of tail of *Lutra perspicillata*.

2. Same cross-section view of *Lutra lutra*.

A. Rhinarium of *Lutra perspicillata*.

B. Rhinarium of *Lutra lutra*.

7½ kg (16½ lb) for males. The hind foot averages around 12 cm (4½ in.) and the ear 15 mm (0.58 in.) in length.

Females generally have only two pairs of mammae (D. Harrison, 1968) which is less than typical specimens of *L. perspicillata*.

**Distribution and Status:** It formerly occurred throughout all the Himalayan river systems extending in summer to small mountain torrents as high as 3500 m (12,000 ft) elevation.

Because its fur is of great commercial value it has been much persecuted, apart from its coming into conflict with government programmes to develop trout fisheries in the north. It has therefore become rare in all the more accessible regions such as the Kaghan, Swat and Chitral River valleys. It



Distribution Map 50 Common (or Himalayan) Otter.  
Smooth-coated or Indian Otter.

still occurs in the northern valleys of Chitral, Swat Kohistan, Gilgit and Baltistan. Skins of the Himalayan Otter reach the fur shops of Peshawar and Rawalpindi from the Jhelum and Neelum Valleys of Azad Kashmir as well as Hazara District but most furriers admit that they have been receiving much smaller numbers in recent years. In 1967 an uncured skin was fetching Rs.80/- (£7.30) in Chitral bazaar.

**Biology:** The Common Otter has been extensively studied in its European habitat and a good deal is known about it (C. J. Harris, 1968). They appear to be intelligent animals with an unusual predilection for play activity indirectly associated with hunting. They also appear to form lasting pair relationships and even family groups remain together for several months. Well written accounts of pet otters have further focused attention upon their playful habits (Maxwell, 1960).

Though relatively clumsy on land, running with arched back and a galloping sort of gait, they are incredibly graceful and swift in the water. When pursuing fish under water they propel themselves by the hind feet only with the fore paws tucked into the breast. They are capable of lightning twists

and turns deploying the powerful muscles of their tails for this purpose. They live principally upon fish but will eat frogs, fresh-water crayfish and any water fowl which they can surprise and overcome. In Pakistan in summer this otter feeds mainly upon the Snow Trout (*Diptychus maculatus*) and Pocock (1941) reports that there is some migration to streams at higher altitudes during the summer. The Snow Trout inhabits streams up to 3500 m (12,000 ft) altitude and in the Deosai Plateau of Baltistan literally swarms in the summer so that it must provide an abundant food supply. They also eat other Himalayan species of fish such as *Oreinus richardsoni*, and Fresh Water Crayfish (*Astacus* species). Col. Ward writing about Kashmir (1927) stated that they return in winter to favourite pools in the lower valleys.

Otters are mainly nocturnal in hunting activity and shelter by day in burrows in the banks of rivers. These burrows usually have their entrances below water level and are thus difficult to locate. Quite often they are excavated under the roots of a tree growing on the bank. The burrow slopes upwards, terminating in a chamber which is well above water level and dry. In studies of European individuals of this species it was found that they habitually migrate over various stretches of river often covering as many as 80 km (50 miles) during the normal annual cycle of activity (C. J. Harris, 1968). They are quite vocal, especially when excited, calling to each other with a staccato repeated mewling. When alarmed or highly excited their call is a higher pitched scream almost like a whistle. Even in the wild, otters often chase each other in play and make mud slides down river banks. They will also juggle with a piece of shell or smooth pebble for prolonged periods. Otters mark their territory by rubbing their anal gland on stones or clumps of grass.

The Common Otter has been shown to have delayed implantation of fertilized ova with a gestation period varying from 288 up to 380 days (C. J. Harris, 1968). Copulation always takes place in the water and in Pakistan young are always born in the spring or early summer. In the European population litters generally consist of 2–4 young and they are blind and almost helpless at birth (Corbett, 1966). They do not venture into the water until they are between two and three months of age and do not become fully weaned until about four-and-a-half months old.

Females are sexually mature at about three years of age. Captive otters have lived to 19 years of age.

**Subgenus LUTROGALE** Gray, 1865

**Key to Subgenus and Pakistan Species of LUTROGALE**

Distal portion of tail flattened with distinct lateral keels and being triangular in cross section. Upper margin of rhinarium more smoothly convex. Pelage sleek (see Fig. 42).

#### LUTRA PERSPICILLATA

*Lutra perspicillata* Geoffroy, 1826; Smooth-coated Otter, Indian Otter (see Illustration 31).

Subspecies *L. perspicillata sindica* Pocock, 1940; Sind Otter

**Description:** The Smooth-coated Otter is similar to the Common Otter in size, colouration and appearance. However specimens from Sind and Bahawalpur region tend to have a slightly paler colouration, their coat when dry being sandy-olive rather than dark brown. Also adults tend to average heavier than the European population of the Common Otter.





Illustration 31 *Lutra perspicillata*: Smooth-coated Indian Otter. (Based on sketches of captive specimens, Lahore Zoo from the Ravi River, Punjab.)

They can be easily separated from *Lutra lutra* upon close examination by two features. The upper border of the naked nose pad or rhinarium forms a smooth convex outline (see Fig. 42). The tail is more flattened ventrally when compared with *Lutra lutra*, with only the upper surface being rounded so that in its distal portion it is more or less triangular in cross section. Like the Common Otter it has a thick heavy body, short limbs and a powerful muscular tail. The belly fur varies from a faded buffy-white to silvery-buff merging gradually into the darker brown of the flanks. There is no marked difference in the texture of its pelage as compared with *Lutra lutra* except for the fur being slightly shorter. The name Smooth-coated Otter is therefore somewhat misleading.

A large male from Sind weighed 10kg (22lb). Average of four specimens from the Indus River is 62.5cm (24.6in.) head and body length (range 59–64cm (23¼–25¼in.)), with the tail averaging 40cm (15¾in.) (range 37–43cm (14.55–16.9in.)) with the hind foot averaging 133mm (5¼in.) and the ear 23mm (0.87in.). Like *Lutra lutra* there is a glandular pouch surrounding the anus and the feet have comparatively short blunt claws. Females have three pairs of mammae.

**Distribution and Status:** *L. perspicillata* is essentially a plains species found throughout the lower Indus riverine system and up to the outer foothills of the Punjab. It sometimes enters tidal waters and has been seen at Keti-bunder. It will frequently enter man-made canal systems as well as inundation storage reservoirs, swamps and lakes, often situated at considerable distances from the main rivers. In all cases it is an inhabitant of warmer sub-tropical regions and generally in conditions where the water is heavily silt-laden and smooth flowing. At one time common in the lower reaches of the

Indus, particularly around Sukkur and the East Nara in Sind, it has become comparatively rare even in these regions largely through increased human settlement on the banks of the Indus River together with the reduction in habitat as a result of irrigation barrages across the Indus and drawing off of the water for irrigation schemes. In recent years I have only encountered evidence of plentiful tracks of this otter on the Chenab River upstream of Marala, and around Sundari Lake (Dhand) in the east Nara swamps of Sind, as well as about 25 kilometres (15 miles) upstream of Sukkur Barrage, and near Tando Muhammad Khan. Occasional individuals have been seen on the Ravi at Sidhnai and also a family party in the storage reservoirs at Lal Sohanran.

Outside of Pakistan this otter extends throughout peninsular India to Malaya, Indo-China and southern China. It has recently been discovered as occurring in the marshes of the Tigris River in Iraq. The Smooth-coated Otter has been much hunted for its skin and the professional fishing tribes of Sind (Mirbars) still trap the young and train them to assist in catching fish. Every sizeable lake in the plains is nowadays rented to professional fishermen by various government departments and these fishermen destroy any otters which they encounter in order to eliminate any competition for fishing stocks. J. A. Murray (1884) when writing about Sind described the clusters of boats which formed the fishing villages on the Indus where one could see as many as 20–30 tame otters (*L. perspicillata*) tethered by the waist, some lying basking in the sun and others playing with children in the sand. Today in such villages only an occasional captive otter can be encountered. If this otter is to continue to survive in Pakistan special measures will have to be taken for its total protection. (See Distribution Map 50.)

**Biology:** The Smooth-coated Indian Otter seems to be a more sociable and gregarious species than *Lutra lutra*. Dunbar Brander (1931), in central India, once counted 22 members of this species in one pool, which he thought were fishing cooperatively. Jerdon also recorded seeing this species hunting in parties in south India on the Malabar coast. Eates (1968) also found a colony hunting together in a creek near the Makli Hills.

This otter will hunt for every species of fish which occurs in the Indus River and they are known to be particularly fond of Murrel (*Ophiocephalus striatus*) as well as Cat Fishes (*Seluridae* species). They are also known to feed on the Indus River crayfish (*Macrobrachium malcolmsonia*) which grows up to 25.5cm (10in.) in length and inhabits the Indus from Ketu Bunder up to Nowshera. They will also eat frogs and occasionally succeed in killing birds and rodents (E. Walker et. al., 1964).

The Smooth-coated Otter also travels extensively during the year except the female when she has young cubs. They will travel considerable distances over dry land when necessary. When travelling leisurely they often swim quite slowly with their heads above the surface and using their fore paws to propel themselves. They will lie up in dense reed beds during such migrations if a suitable burrow is not available. They often lie on the bank and sun themselves in some secluded spot. Like *Lutra lutra* they are quite playful and will frequently juggle with pieces of stick or shells. Male Smooth-coated Otters mark their territory by regularly depositing their faeces on prominent grass clumps or hummocks of earth near the embankment. Like *Lutra lutra* they are very vocal when excited, making a very high pitched rapidly repeated scream.

Captive otters of this species have been successfully bred in several zoos. Details of their breeding cycle were recorded from captive specimens in Jaipur Zoo in India (Yadav, 1967). The period of gestation varies from 61–63 days, and implantation of the ova is not delayed in this species. The female remained in oestrus for 14 days during which time the pair were more than usually playful and affectionate. Copulation took place in the water. The newly-born young were well covered with fur but their eyes did not open until ten days after birth and the mother did not allow them to emerge from the den until they were six weeks old. They were three months old before they ate their first fish and did not venture into the water until 46 days old. Probably breeding can occur throughout the year. A litter of five kittens of *L. perspicillata* was captured in southern Sind in early September and appeared to have been born in late August. Smooth-coated Otters have lived 11 and 16 years in captivity (Dover, 1932).

#### FAMILY VIVERRIDAE – CIVET CATS, GENETS, MONGOOSES, PALM CIVETS

This family comprises relatively small sized carnivores which include the Civets, Genets and Mongooses. Confined to the Old World, they are mainly tropical or subtropical in distribution being particularly well represented in Africa. They are thought to be related to the *Felidae* but are distinguished from the latter by having five digits on the hindfoot and by having a longer and more slender muzzle. Generally they have shorter legs than the *Felidae* though they are much longer legged than the *Mustelinidae*. They exhibit a wide variety of fur patterns and colouration.

#### Key to the Family VIVERRIDAE

Small sized, slender built carnivores with relatively short legs and comparatively large ears with well developed bursa on the external margin. Anus not enclosed in a glandular sac but with perineal scent glands in genital region. Prepuce in males located well in front of scrotum.

#### SUBFAMILY VIVERRINAE – CIVET CATS

Having perineal scent glands not enclosed in a special anal pouch.

#### Genus VIVERRICULA Hodgson, 1838

#### Key to the Genus and Pakistan Species of VIVERRICULA

External ear pinna rounded not pointed with their anterior margins set close together on the crown. No dorsal crest of longer hairs. Claws unprotected by sheaths of skin.

Head and body 50–62cm with tail half as long and conspicuously ringed with alternate yellowish-white and black bands.

... *Viverricula indica*

#### VIVERRICULA INDICA

*Viverricula indica* Desmarest, 1817; Small Indian Civet or Rasse (see Illustration 32).

**Description:** The Small Indian Civet is somewhat cat-like in general appearance having relatively long fore legs and conspicuous rounded ears. In size it is slightly smaller than the Desert Cat (*Felis libyca*) which often occurs in the same area. Adult males vary in weight from 2.5–3.4kg (5½–7½lb) (Shortridge, 1914). A specimen from near Okara weighed 2.2kg (4lb 12oz). The head and body measures 45–63 cm (18–24½in.) whilst the tail averages 36.9–41.3cm (14½–16½ in.). A specimen from Jhang measured 56cm (22in.) head and body length with the tail 42cm (16½in.) and stood about 45.7cm (18in.) at the shoulder.

It is an attractive animal with a slender pointed muzzle and bright alert appearance. The naked rhinarium is reddish-brown and the hairs around the muzzle are whitish. The ears are broad and very rounded in outline with their inner or anterior margins almost meeting in the centre of the crown. The backs of the ears are whitish with a bursa on their outer margin. There is a conspicuous region of smooth black hair below the inner corner of each eye. The general body colour varies from sandy-buff to greyish-white and is heavily spotted with black in parallel horizontal lines. The spots are smaller in the region of the spine where they tend to coalesce into continuous lines but become larger on the lower flanks. All four legs are black or very dark brown and often there are small patches of white fur around one or more of the paws. The belly fur is dark grey in colour and tends to be rather thin and sparse, the body fur is coarse and harsh to the feel with practically no under fur. Consequently it is not highly esteemed by the fur trade. The tail is long and bushy but tends to taper to a point with the hairs laterally compressed particularly in the proximal region. Dorsally the tail is a rich orange or ochraceous colour fading to buffy-white on its ventral surface and it is conspicuously marked with 9–10 concentric black rings. The throat and breast are greyish-white with two thick black semi-circular bands on the upper throat, reminiscent of a mayor's chain of office. The hairs on the chest grow outwards from a natural parting down the middle,



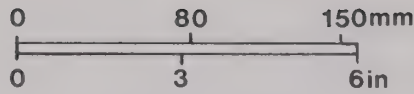


Illustration 32 *Viverricula indica*: Small Indian Civet or Rasse. (Based on captive specimen in possession of J. A. W. Anderson, sub-adult female from near Mirpur Sakro, Sind.)

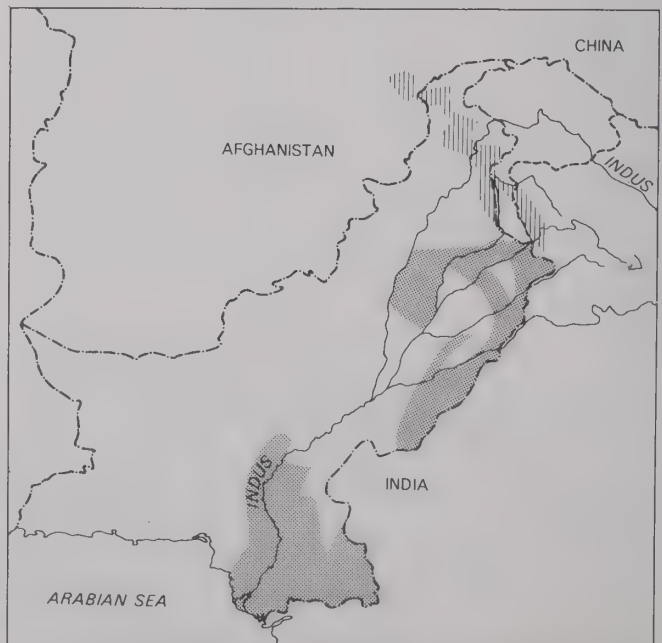
giving the breast a cleft appearance. When viewed from in front the broad round ears and prominent chest pattern are particularly striking.

Like all the civets it has plentiful and strong vibrissae round the muzzle, and these are both white and black in colour. There is a scent gland situated in the perineal region. The claws are non-retractile but sharp and well developed. The female has six teats, located ventrally.

**Distribution and Status:** This is the best adapted of all the civets in the sub-continent to terrestrial hunting and semi-desert conditions. It will be found in a variety of habitats in the Indus basin including riverine jungle and extensive sand-dune desert regions. It also favours irrigated forest plantations and seems to avoid highly settled cultivated areas as well as mountainous regions.

In Pakistan it appears to be decidedly uncommon and erratic in distribution and there is no evidence of its having extended its range west of the Indus River. A typically oriental faunal zone species, it seems most likely to occur in the extreme border regions. Thus a specimen was killed near the University of Punjab New Campus in the late 1960s (Z. B. Mirza, pers. comm.) as well as in a swampy area near the Ravi River around Baratpur by Mr. Krebb in 1969. They seem to be plentiful further south around Bahawalnagar and in Lal Soharan Forest Plantation (Rana, D. F. O., pers. comm.) I have two records of specimens killed on the road near Okara and Chichawatni Forest Plantation as well as a specimen trapped between Jhang and Sargodha. Also a sighting of a specimen in broad daylight near Leiah in the Thal District (C. Priddy, pers. comm.). The species occurs sparsely in the

Salt Range and the Margalla Hills and was collected in Campbellpur District by the Bombay Natural History Society's Mammal Survey. Eates (1968) considered the Rasse to be rare in Sind even during the 1940s though local 'Jogis' (animal



*Viverricula indica* (stippled pattern)  
*Paguma larvata wroughtoni* (vertical lines pattern)

Distribution Map 51 Small Indian Civet or Rasse. Himalayan Palm Civet.

trappers) claim that it is relatively common in Thatta District and around the lower reaches of the Indus. There are also records of its occurrence around Sukkur and Tharparkar. There is no evidence of its having occurred in Baluchistan or in the North West Frontier Province or in the Himalayan regions of Pakistan.

Extra-limitally it extends throughout most of India, Ceylon (Sri Lanka), Burma, Malaysia and southern China. It has not been recorded in Iran, Afghanistan or Russia.

It is too rare to be of any economic importance in Pakistan though because of its secretive nocturnal habits it may be more widespread than is presently known.

**Biology:** The Rasse is seldom encountered because it is normally solitary in hunting and strictly nocturnal in activity. They are quite omnivorous in feeding habits being capable of subsisting entirely on fruits at certain seasons as well as a variety of insects and Arthropods. A specimen in Kathiawar (India) had the remains of beetles, the stones of the Ber fruit (*Zizyphus jubata*) and an unidentified finch in its stomach (BNHS Survey, 1913). A specimen was trapped at Kalabagh feeding upon ripe grapes (the late Nawab of Kala Bagh, pers. comm.). Observations on a young captive female, allowed to run free, indicated that they hunt both by scent and hearing. They will kill and eat any small mammal, bird or lizard which they can catch as well as robbing birds' nests and eating the eggs or nestlings. Though it has been stated that it does not climb readily (Walker et al., 1964) they can climb with agility and have been observed feeding on Ber (*Zizyphus jubata*) fruit growing on the slenderest branches.

The Rasse will dig readily and probably excavates its own burrow and spends most of the day sleeping underground. It is believed that pairs do not form lasting bonds and that the male takes no part in rearing the family. Eates (1968) saw a pair together near Sukkur in the early Summer. Prater (1965) states that the young are born at all seasons of the year with litter sizes varying from 3–5. A young Rasse captured near Thatta appeared to have been born in March. The young are born in a hollowed out chamber at the end of a simple burrow.

In captivity they display a gentle nature and rarely bite when handled which is in sharp contrast to mongooses. A captive female was seen to rub its scent glands at regular intervals on various parts of the furniture when allowed free range in the house. It did this by raising its tail and straddling its hind legs. Such marking is typical of territorial mammals which are normally solitary and whose population is not very dense. Captive specimens have lived for 7 and 8 years (Dover, 1933).

#### SUBFAMILY PARADOXURINAE

This subfamily comprises more arboreally adapted species which consequently have a relatively longer tail to assist in climbing and a more extensive naked plantar pad on the hind foot, being plantigrade in gait.

#### Key to the Subfamily PARADOXURINAE

Anterior margin of ears widely spaced on crown. Body fur lax, often with a pattern of dorsal stripes. Tail uniformly coloured. Dorsal crest extending down neck and shoulders.

#### Genus PAGUMA Gray, 1831

#### Key to the Genus and Pakistan Species of PAGUMA

Without pattern of stripes or spots on the body. Tail over

two-thirds length of head and body. Irregular pattern of greyish-white hairs alternating with black or dark grey on face.

Large size. Head and body 60–65 cm. Vibrissae all white, up to 90 mm in length. Eyes encircled by greyish-white hairs contrasting with darker grey-black on lower cheeks and muzzle.

... *Paguma larvata*

#### PAGUMA LARVATA

*Paguma larvata* Hamilton-Smith, 1827; Masked Palm Civet  
Subspecies *P. l. wroughthoni* Schwarz, 1913; Himalayan  
Palm Civet (see Illustration 33).

**Description:** This species well illustrates the wide variation in appearance of the different members within the Family *Viverridae*. It is a much larger, heavier bodied animal than the Rasse with a relatively longer tail which is cylindrical and thickly muscular in its proximal portion, and fore-limbs which are relatively short but very muscular. Generally the tail is about two-thirds of the head and body length. It has a smaller sharp pointed muzzle and broadly rounded ears but the skull is much broader than that of the Rasse (see Fig. 41) and the ears are widely separated. An adult male killed at Malach in the Murree Hills weighed 6 kg (13 lb). Its head and body measured 73 cm (28½ in.) and its tail 56 cm (22 in.) with the hind foot 10 cm (3.9 in.) and the ear 5.4 cm (2.1 in.). Females may be 60–65 cm (23.6–25.6 in.) in head and body length with the tail varying from 45–50 cm (17.7–19.6 in.).

The body colour of the Himalayan Palm Civet is rather variable but the general tones are greyish-black with the extremities almost pure black. Some individuals show warmer ochraceous tones around the flanks and some have the tips of the guard hairs reddish-brown. The fur is rough and harsh to feel with a thick pale grey or yellowish-grey under fur in winter and summer. The lower part of the limbs is black with five digits on fore and hind feet. These bear strong curved semi-retractile claws and extensive naked pads both under the fore and hind feet which are black in colour with a rugose (granulated) texture (see Fig. 43). Generally the tips of the longer guard hairs are black and in adult specimens there is a slight crest of longer hairs running down the nape and over the shoulders. The tail is not very bushy, in fact it is tapered in its proximal portion which is thicker tending to have a mixture of reddish-brown hairs and the slender tip being blacker. The belly fur is paler than the flanks and of a greyish-buff colour.

The face has a regular black and greyish-white pattern which gives rise to the name Masked Palm Civet. This pattern varies from one individual to another but there is usually a semi-circular band of creamy-white hairs behind and below the eyes which does not meet across the forehead, and there may be a distinct line of grey tipped hairs running down the centre of the forehead. The rhinarium is black and naked (see Fig. 43) whilst the lips and gums are purplish-black in colour. A striking feature is that the vibrissae which are plentiful and strongly developed are always entirely white.

Some sub-adult or immature specimens show traces of two longitudinal black stripes on either side of the spinal region, which is a pattern exhibited by the Common Palm Civet (*Paradoxurus hermaphroditus*). In fact, because of considerable individual variation in body colour it is difficult to separate these two species on the basis of external appearance alone, although adult specimens of *Paguma larvata*



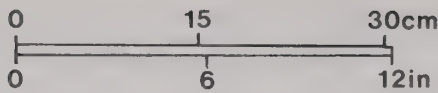


Illustration 33 *Paguma larvata*: Masked Palm Civet or Himalayan Palm Civet. (Based on fresh killed specimen, adult male from Malach, Murree Hills.)

never show longitudinal body stripes. Also females have only two pairs of mammae whilst *Paradoxurus* has three pairs.

**Distribution and Status:** This is a mountain species which in Pakistan is associated with the warmer foothill tracts and typically with the tropical pine zone (*Pinus roxburghii*). It frequently occurs in relatively treeless regions where the hillsides are terraced for cultivation with scattered patches of mixed coniferous and deciduous forest. It is absent from the plains or the inner dryer Himalayan mountain regions.

It occurs widely in lower Swat as well as the Neelum Valley of Azad Kashmir. It also occurs in the Murree Hills. There are no definite records of its occurrence from either Dir or Chitral, though it may occur, since an occasional skin of this species reaches the fur traders in Kabul, Afghanistan which are alleged to come from Nuristan (J. Niethammer, in lit.).

Pakistan appears to form the extreme western limit of its range, where it is now very restricted in distribution and uncommon. Although the fur of this animal is not particularly sleek or beautiful it is constantly trapped and shot and the furriers of Peshawar and Rawalpindi usually have a number of *Paguma* skins for sale. Most of these appear to come from Swat. Since they often take ripening orchard fruit and kill domestic fowls they come into conflict with local farmers in the relatively well settled outer hill ranges where they occur.

Extra-limitally it is found throughout the Indian Himalayas and the Assam hill ranges. It also occurs in Burma, Malaysia and Indo-China. The species has not extended its range into Russia or Iran. (See Distribution Map 51.)

**Biology:** The Himalayan Palm Civet is mainly an arboreal species and they can run up a vertical tree trunk with surprising speed and agility. They are mainly nocturnal in foraging spending the day asleep in a hollow high up in a tree or occasionally in rock crevices. On two occasions in the Murree Hills the Himalayan Palm Civet has been observed trying to attack domestic poultry in the middle of the day, so they are not exclusively nocturnal. On the second occasion the animal was observed close to a human habitation in mid morning and was killed with the aid of dogs.

In diet they are largely frugivorous at certain seasons and there are many instances of their raiding apricot, pear and apple trees when the fruit is ripening. They will however kill any bird or rodent which they can surprise. In Kulu (India) two adult specimens were trapped after they repeatedly consumed tomatoes which were placed to ripen in boxes (Martin, 1929). These captive specimens stood upon their haunches to eat small fruits, holding these between their fore-paws. Large fruits, such as apples were held on the ground between the fore-paws and gnawed at like a dog with a bone (Martin, op. cit.). Two other captive specimens ate raw fruit and any kind of vegetables including potatoes readily, both would also eat chapattis (whole-meal unleavened wheat pancakes) and enjoyed drinking milk. One specimen was very fond of butter (Mr. J. Dudley-Woodberry, in lit.).

The Himalayan Palm Civet appears to be mainly solitary. They have four small glands around the anus from which a thick yellow fluid with a highly noxious smell is discharged when the animal is frightened or alarmed. The captive specimen kept for about 4 months by the Woodberrys, however,

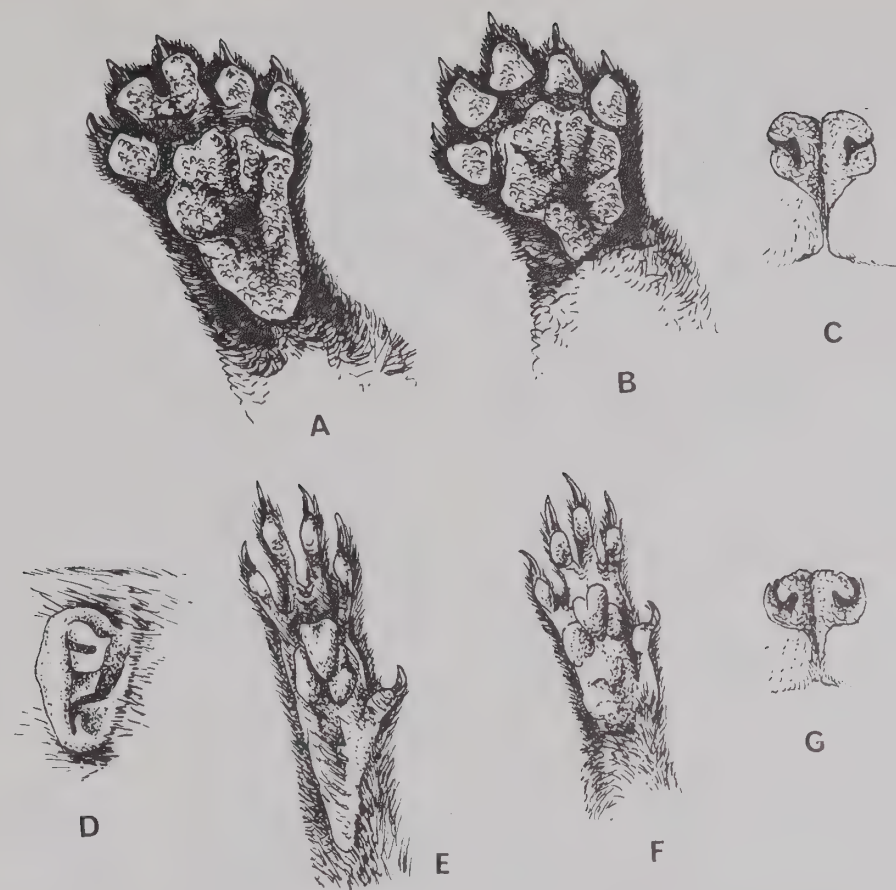


Fig. 43 Showing details of arboreal Palm Civet and fossorial Mongoose.

- A. Right hind foot, dorsal view of *Paguma larvata*.  
 B. Same right fore-foot.  
 C. Rhinarium of *Paguma larvata*.  
 D. Right ear of *Herpestes edwardsi*. This is normally

- partly concealed by a fringe of hair.  
 E. Right hind foot, underside of *Herpestes edwardsi*.  
 F. Right fore-foot of same. Note long claws adapted for digging.  
 G. Rhinarium of same.

never did this though frequently handled. If handled by strange persons it scratched fiercely though it would not do this even when roughly handled by children with whom it was familiar (Mrs. D. Woodberry, in lit.). Their claws are quite retractile and a young male kept by me used its claws to run up one's trouser legs, especially if the cloth was loose, whereas at other times these claws were hardly visible. Though not prehensile, the tail is also an important balancing organ in climbing, being used to press against a surface whilst the legs stretch across open spaces. They have a number of vocalizations. When pleased or demonstrating affection a rather short duration 'purr' like a cat and when angry another call is a soft quickly repeated 'chip-chip'. Other authors have referred to a staccato call between a snort and a sneeze (Martin, 1929). By day my captive specimen slept curled into a tight ball with its head tucked into the belly and encircled by the long tail in such a way that it was difficult to ascertain which was the front part of its body. It preferred to crawl into a narrow space such as an empty carton or open cupboard, before sleeping.

The prominent white whiskers are apparently important tactile organs. It has been observed that they can be twisted forwards so that they touch the object before the Palm Civet decides whether it is edible or not (Martin, 1929).

Not much is known about their breeding habits. A young specimen captured near Murree appeared to be about one month old when first obtained in July. At this time its head

and body length was about 20.3cm (8in.) with the tail seemingly longer. Another young male from Kawai in the Kaghan Valley, appeared to be about three months old when purchased by me from a village boy on 1 July. A captive female at Regents Park Zoo (London) produced a litter of two in April (Zuckerman, 1953). Pocock (1939) also records a litter of three born in the London Zoo in early summer and Prater (1965) records a litter of four found in Nepal which was concealed in a hollow tree. The young open their eyes nine days after birth and grow very rapidly, being almost equal in size to their parent at three months of age. When newly born the longitudinal black spinal stripes are conspicuous whereas the white facial pattern is indistinct. Presumably in Pakistan most litters are produced in the spring or early summer when living conditions are least harsh.

Captive specimens have lived for 11 and 15 years (Dover, 1933).

#### SUBFAMILY HERPESTINAE – MONGOOSES

This subfamily comprises the mongooses distributed throughout the tropics and subtropics of the Old World and being best represented in Africa where 17 different species occur.

They are more terrestrial and fossorial than the Civets and are well adapted for digging, with long non-retractile claws. The male has a short baculum (*os penis*).



### Key to Subfamily HERPESTINAE

Lacking perineal scent glands but having a naked glandular pouch around the anus. The prepuce situated close to the scrotum. External ear pinna much reduced and lacking any marginal bursa. In lateral silhouette ears do not protrude above skull. Body fur coarse with hairs annulated black and buff.

### Genus HERPESTES Illiger, 1811

#### Key to the Genus and Pakistan Species of HERPESTES

Five digits on fore and hind feet with claws long and fossorially adapted (see Fig. 43). Tail over two-thirds of head and body length and tapering to a slender point with longer hairs proximally.

- (a) Size small. Head and body 30–35cm, hind foot 5–6cm, skull 60–70mm. Pelage short, about 15mm long on the back.

... *Herpestes auropunctatus*

- (b) Size larger. Head and body 36–45cm, hind foot 8cm and skull 7–8cm. Pelage long, with rufescent tones. Dorsally fur up to 40mm in length.

... *Herpestes edwardsi*

### HERPESTES AUROPUNCTATUS

*Herpestes auropunctatus* Hodgson, 1836; Small Indian Mongoose or Gold Speckled Mongoose (see Illustration 34).

Synonym *Herpestes javanicus* Pocock, 1937.

**Description:** This is a small ferret-like animal with a long tapered tail roughly three-quarters of the head and body length, short sturdy legs and a sharp pointed conical face. The fur is relatively coarse and long without any underwool and the individual hairs are annulated with black and golden-buff varying to olive-buff. This gives the pelage a 'pepper and salt' appearance when viewed close up, though from a distance the general colouration appears a dark olive-brown. The belly fur is a paler creamy-buff with rusty tinges around the chest. The naked rhinarium is blackish and the hair around the eyes and tip of the muzzle is usually also rusty-red. The ears are very small and lie partially concealed in the body fur being low-set on the crown. There is no bursa in the outer margin of the ear pinna which bears complicated folds inside the conch. The iris is dark brown. There are five digits on fore and hind feet armed with relatively long claws and the feet have naked black soles. The first digit is much shorter than the remaining outer toes. Two adult males from Sind had the head and body 25 and 32 cm (10 and 12½ in.) long, with the tail 20 and 24 cm (8 and 9½ in.) respectively. The hind foot averaged 48 mm (1.8 in.) and the ear 23 mm (0.8 in.). The larger specimen weighed 907 g (2 lb).

As indicated above the tail of this species is not very bushy and tapers to a thin point and the longest body hairs are generally under 20 mm (0.75 in.) in length but about 12 mm (0.5 in.) in the mid dorsal region.

**Distribution and Status:** The Small Mongoose is well adapted to living in the outskirts of villages and towns and is more commensal than the other species *H. edwardsi*. It avoids mountainous areas and is absent from the Himalayan regions and it also avoids extensive sand-dune areas. It is

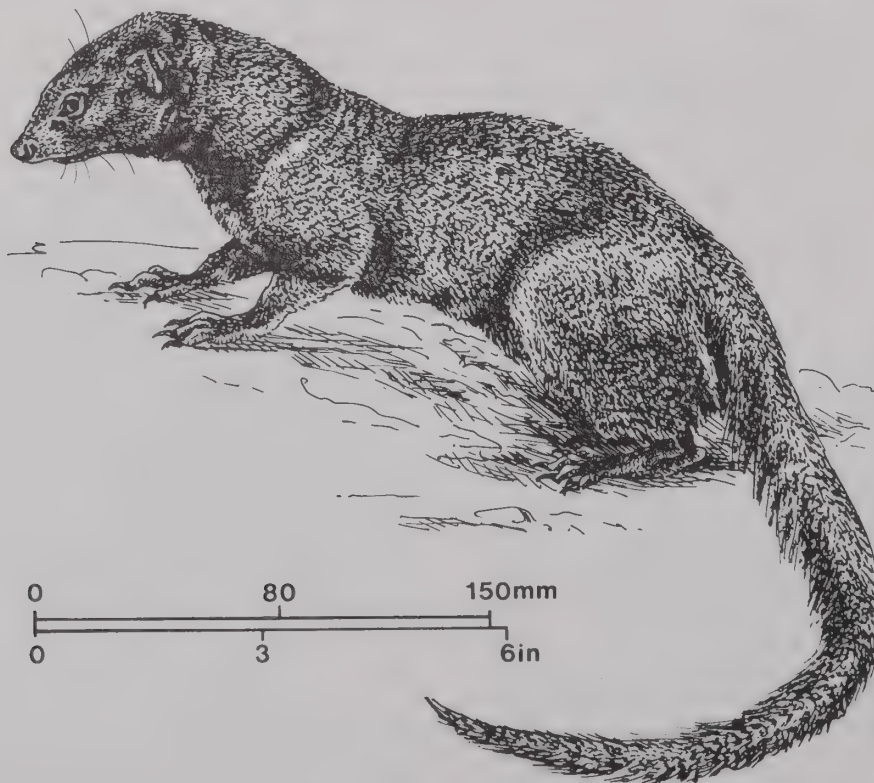


Illustration 34 *Herpestes auropunctatus*: Small Indian Mongoose or Gold Speckled Mongoose. (Based on live captive specimen from the University New Campus, Lahore.)

typically associated with the better wooded regions of the Indus plains having a slightly higher rainfall and it thus shows the distribution of a typical oriental faunal zone species.

The Small Indian Mongoose is particularly plentiful in southern Sind extending throughout Tharparkar, Thatta and Dadu districts. It occurs sparsely in Bahawalpur Division and I have only once observed it in southern Punjab near Khanewal where *Herpestes edwardsi* is common. It is common around Lahore, Kasur and Sialkot Districts and I have also observed wild specimens around Jhelum and Gujranwala. It occurs in the Salt Range of the Punjab and seems well adapted to living in more rocky areas with stunted thorn scrub typical of both the Salt Range and south west Sind. It has spread westwards through southern Baluchistan and has been collected at Turbat in the Mekran but it has not spread northwards into the higher mountain regions of Baluchistan.

Extra-limitally it occurs sparsely in the east and west corners of southern Iran (Lay, 1967) and also in south western Afghanistan where it seems to be numerous around Girishk, extending to Herat (Hassinger, 1968). Further west it has only been collected in Iraq around the Tigris River (D. Harrison, 1968). It is widespread throughout India, Nepal, Assam, Burma, Malaysia and Thailand.



*Herpestes auropunctatus*

Distribution Map 52 Small Indian or Gold Speckled Mongoose.

In Pakistan this Mongoose is one of the commonest small carnivores in southern Sind as well as the north east Punjab and it is beneficial to man as it preys on small rodents as well as a variety of poisonous arthropods and harmful insects.

**Biology:** The Small Indian Mongoose is largely diurnal in its hunting and foraging but in the precincts of cities and villages they will hunt by night. Though an active burrower, they will also make use of a variety of man-made drains, culverts and crevices under buildings. During the warmer months they shelter in their underground burrows throughout most of the day. They are active and agile, their normal gait being a rapid trot with the spine straight in contrast to the typical arched spine and galloping progress of most

Mustelinidae when on the ground. They can climb trees and up wire-netting and will enter water and swim if forced to do so. They appear to have a highly developed sense of smell, hearing and vision in hunting and will often sit up on their hind legs in order to get a better view while out foraging.

This mongoose when it lives around human habitations lives largely on rodents such as *Rattus rattus* and *Mus musculus*. A specimen captured in Rajasthan (India) in a desert region had its stomach full of the remains of three species of beetle (*Blaps orientalis*, *Anthia sexguttata* and *Onthophagus longicornis*) also the remains of scorpions (Prakash, 1959A). It will also tackle snakes and lizards, solifugid spiders and amphibia. It will also kill any small birds which it can overcome and is particularly fond of eggs. In Lahore Zoo I have observed wild specimens of this mongoose enter the cages of larger carnivores to steal fragments of meat as well as pieces of chapatti (unleavened wheat bread) from other cages.

The breeding of this species in captivity has been described by Powell (1913). He kept a tame female in the eastern part of the Punjab (India) which paired with a wild male on 11 July producing a litter of three after a gestation period of just over six weeks. He noted that the mother, perfectly tame at other times, became fiercely protective and savage during the time of birth of the young. It is believed that this mongoose is capable of producing two or three litters in a year and that the breeding is not particularly confined to any one season. Most records of breeding in the wild however seem to be around the end of the summer, coinciding with the monsoon season when not only insect life is abundant but amphibia and reptiles are also conspicuously available. The newly born young at birth are blind, practically naked and very helpless and their eyes do not open until the sixteenth or seventeenth day. Powell (1913) noted that the young actually made a purring noise when suckling which seemed to express pleasure and that a captive adult even purred regularly when given a dish of milk.

Except when the young accompany their mother in the early stages of their life, this mongoose is usually solitary in hunting. They can be quite bold and fearless in the presence of humans and live trapped specimens will make spitting and snarling noises like a cat. They are highly inquisitive and it is interesting to observe a wild specimen checking into every tree root, crevice, and cracks beneath mud walls. Captured specimens have lived seven years (Dover, 1933).

## HERPESTES EDWARDSI

*Herpestes edwardsi* Geoffroy, 1818; Indian Grey Mongoose or Common Indian Mongoose (see Illustration 35).

Subspecies *H. edwardsi ferrugineus* Blanford, 1874; Desert Mongoose

**Description:** Considerably larger than *H. auropunctatus*, the Grey Mongoose is easily distinguished in the field by its longer contour hairs which form almost a cape along the flanks and over the hind quarters. The hairs at the base of the tail are long reaching up to 55 mm (2¼ in.).

Like *H. auropunctatus* the fur is rather stiff and coarse, the individual hairs being annulated with creamy-white and black, the longer hairs having as many as 8 to 10 alternate bands of colour. There is scanty woolly under-fur which is generally of a reddish-buff colour and this species tends to show more signs of erythrism with the hair around the muzzle and eyes being rusty-red. Even the darker annulations



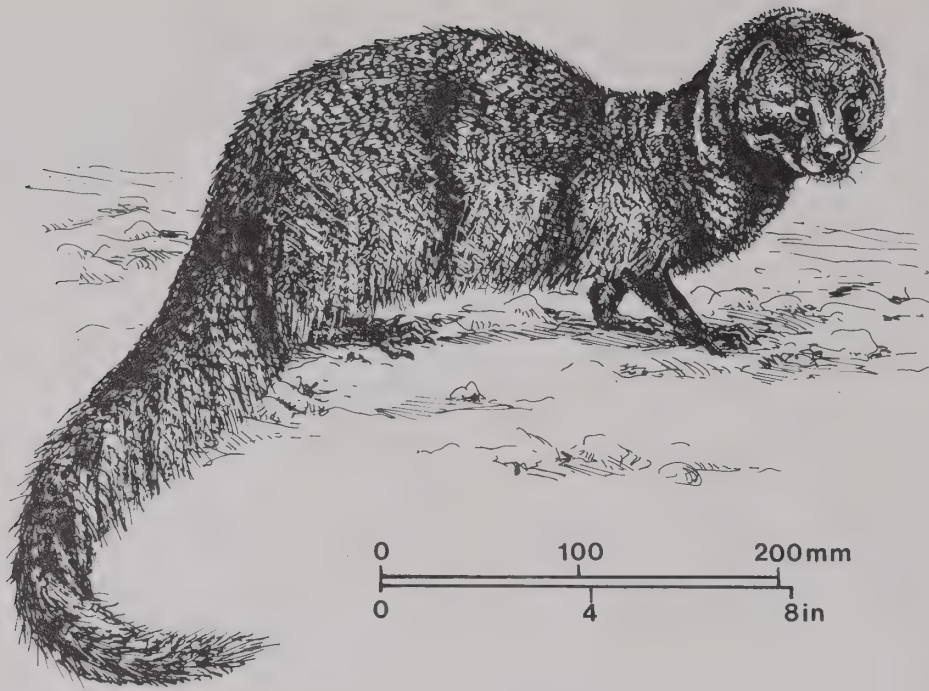


Illustration 35 *Herpestes edwardsi*: Indian Grey Mongoose.  
(Based on sketches and photographs of free wild specimens, Khanewal, Punjab.)

on the contour hairs show dark reddish-brown tones. Generally the whole of the ventral surface is covered with coarse short hairs of an orange-brown tone and the upper part of the feet and limbs is a darker reddish-brown. The ears are partially concealed in the body fur and the pinna bears peculiar folds (see Fig. 43). The head is characteristically conical with the fore crown sloping straight to the pointed nose. The naked rhinarium is reddish-brown and the vibrissae are rather short and scant, considering its fossorial habits (see Fig. 43).

The sub-species *H. e. ferrugineus* is distinguished by its generally paler colouration with a greater tendency for replacement of the dark speckling by reddish-brown (Pocock, 1941). Actually both pallid greyish and rufous forms occur throughout Pakistan in the same areas according to my observations, and this is corroborated by the collecting localities of the fine series of skins in the British Museum.

Typical specimens from the Punjab and Sind have the average head and body length 393mm ( $15\frac{1}{2}$ in.) (range 355–430mm ( $14\frac{1}{2}$ – $16\frac{1}{2}$ in.)) – with the tail 337mm ( $13\frac{1}{4}$ in.) (range 320–390mm ( $12.6$ – $15.35$ in.)), the hind foot 77mm (3in.) and the ear 22mm (0.87in.) in length. A freshly killed male from near Pattoki weighed 1.3kg (3lb).

There is a wide sac-like pouch surrounding the anus. The scrotum is external and located very close to the penis. The female has two pairs of mammae situated ventrally.

**Distribution and Status:** The Grey Mongoose is better adapted to arid conditions than the Small Indian Mongoose and is consequently much more widespread in Pakistan, occurring even in extensive sand-hill tracts as well as the broader valleys extending into the hills on the west of the Indus River. It avoids mountainous areas and generally shuns the vicinity of large towns being much less dependent on human dwellings than *H. auro-punctatus*.

*H. edwardsi* is common throughout the central and northern parts of Sind, particularly the desert tracts of Thar-

parkar. It is common in Cholistan and the south western part of the Punjab. It is curious that *H. edwardsi* is comparatively rare around Lahore and Malir in southern Sind where *H. auro-punctatus* is abundant, though there is no basis for believing that the two species compete for food. It occurs sparsely in southern Baluchistan and also in Kohat and Bannu Districts. Specimens have been collected from the Salt Range and also from near Peshawar and it is plentiful around Rawalpindi. It does not appear to have penetrated into the northern Himalayan regions nor into the Murree foothills.



*Herpestes edwardsi*

Distribution Map 53 Indian Grey Mongoose.

It can be considered as widespread and common throughout the Indus plain and very beneficial to man despite its occasional depredations amongst game birds, since they readily feed on scorpions or venomous snakes and stinging *Hymenoptera* (hornets, wasps).

Extra-limally the Grey Mongoose occurs in southern Iran (Lay, 1967), extending westwards along the shores of the Persian Gulf up to Kuwait and Iraq (D. Harrison, 1968). Pocock (1941) also states that it occurs in Afghanistan though this seems doubtful as there are no such specimens in the British Museum nor has it been collected recently (Hassinger, 1968). It extends throughout India to Ceylon, Nepal and Assam. The population in Malaysia is thought to have been introduced (J. Harrison, 1966).

**Biology:** The Common Grey Mongoose when not disturbed is largely diurnal in hunting. Principally terrestrial they are capable of climbing trees if pressed, and they will readily enter burrows of rodents if pursued. They also excavate their own burrows, the entrance usually being concealed in a bush.

As already indicated they are remarkably adept at hunting and capturing a variety of living creatures. Though apparently hesitating occasionally to tackle large snakes (Stockley, 1931) there are many authentic observations of their killing and devouring highly venomous snakes, such as the Black Cobra (*Naja naja*) in Sind and Russell's Viper (*Vipera russelli*). Its method of attack has been well documented (Sterndale, 1884 and Carrington, 1949). Leaping out of range each time the snake strikes, the reptile soon tires, whereupon the mongoose darts in and seizes it near the head. They appear to be somewhat resistant to the effects of snake venom if bitten superficially (Jerdon, 1874). However, there are authentic records of mongooses being killed by venomous snakes (Sterndale, 1884 and Walker et al., 1964). I once witnessed *H. edwardsi* seize and carry off a House Crow (*Corvus splendens*) in broad daylight but such a strong billed and wary bird must rarely be attacked. Prakash (1959A) found the remains of Grey Partridges (*Francolinus pondicerianus*), incisors of a rodent and part of a Monitor Lizard (*Varanus griseus*) in the stomach of a specimen from Rajasthan. Another had its stomach full of termites and the heads of scorpions. A pet mongoose was observed to take no precautions to avoid being stung when capturing and eating scorpions. In fact it played with them as a cat does with a mouse (Fischer, 1923). The same mongoose was very fond of wasps and hornets which it could snap up in flight. In Khanewal where this mongoose regularly breeds in my garden, I have observed that they will eat the Tiger Bullfrog (*Rana tigrina*) and the Desert Toad (*Bufo andersoni*) both of which are abundant from July to November. They will boldly enter houses if the opportunity presents and steal food such as butter as my wife has learned to her cost. I have twice encountered this mongoose feeding on the remains of a dead dog killed beside the road. On both occasions this was in broad daylight.

The breeding of this mongoose under semi-free conditions has been recorded by Col. Frere (1929) who kept individuals as pets. According to his account a young female became sexually mature at about nine months of age and mated with a wild male. Her first litter comprised two young and she subsequently produced five litters within a space of eighteen months each comprising two young. The gestation period was observed to be about 60 days and on some occasions this specimen mated with her own male offspring. The male took no part in care or protection of the young and the female was in fact very fierce before and after parturition. According to

observations at Khanewal, litters can be produced at any season of the year. Frere (op. cit.) observed that if the female thought her nesting burrow had been detected, she would carry her young in her mouth, like a cat to some safer den. The young are helpless and blind at birth but mature rapidly. If the female does not mate again, the two young will remain with their mother for as long as six months, hunting in a family party.

The *H. edwardsi* regularly marks its territory by rubbing the anal gland on prominent projections. It does this by cocking the inside hind-leg nearest to the object and a rapid sideways movement and I have seen a wild specimen scent a row of three verandah chairs in the space of about ten seconds. Normally not vocal, a cornered specimen, or one live-trapped, will spit like a cat when approached and wild specimens will occasionally attack each other with high pitched chattering screams. When nervous or alarmed they erect their long contour hairs in the region of the lower back and throughout the length of the tail. I have seen this bold little carnivore challenge a domestic cat of larger size, and force the latter to retreat.

Captive specimens have lived over ten years (Crandall, 1964).

#### FAMILY HYAENIDAE — HYAENAS

Comprising three genera inhabiting Africa, south west Asia and southern Russia, they are distinguished from the Canidae by having only four toes on fore and hind feet as well as a sac-like scent gland above the anus.

#### Key to the Family HYAENIDAE

Large size and dog-like with pointed ears lacking any marginal bursa. Front feet with only four digits (see Fig. 86). Having a sac-like scent gland situated above the anus.

#### Genus HYAENA Brisson, 1762

#### Key to the Genus and Pakistan Species of HYAENA

A crest-like mane extends from the head to the root of the tail.

Body fur with yellowish-fawn ground pattern and indistinct vertical black stripes with close set horizontal black stripes on legs.

... *Hyaena hyaena*

#### HYAENA HYAENA

*Hyaena hyaena* Linnaeus, 1758; Striped Hyaena (see Illustration 36).

**Description:** A large, dog-like carnivore with a conspicuous crest of longer hairs extending like a mane from the crown of the head to the pelvis. The head is large with dog-like snout, naked rhinarium and upright triangular ears. The ears lack any bursa or pouch-like fold on their outer margins and they are sparsely haired and black skinned. The legs are relatively long and slim and the animal appears to have comparatively weak hind quarters with high sloping shoulders. The tail, which is short and barely reaches below the hocks, is thick and bushy. The general body colour is tawny-yellow with indistinct broad vertical black stripes along the flanks



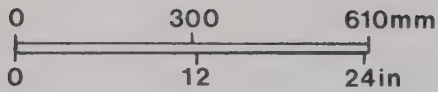


Illustration 36 *Hyaena hyaena*: Striped Hyaena. (Based on captive specimens in Lahore Zoo from Dera Ismail Khan District.)

and numerous more distinct and slender horizontal black stripes around the outer surface of the fore and hind legs. The dorsal crest generally has black hairs predominating and these can be erected when the animal is nervous or excited. The throat and upper chest region is also black. All over the body the fur is coarse and harsh to the feel and in summer coat the pelage is rather thin which has led many earlier writers to describe its appearance as mangy.

The development of the jaws is massive in the Hyaena with powerful muscles attached to a high sagittal crest on the top of the skull (see Fig. 34). Besides lacking any fifth toe, the fore feet are much larger than the hind feet and the non-retractable claws are blunt. There is a large glandular pouch immediately beneath the anus into which scent glands open. The male hyaena has relatively small external genitalia partly concealed by this pouch-like fold of skin and the penis lacks any baculum (*os penis*). The female generally has three pairs of mammae.

An adult male generally stands about 68–76cm (27–30in.) high at the shoulder and may weigh as much as 54½kg (120lb) though 36–41kg (80–90lb) should be more normal. Two specimens from Sind averaged 104.8cm (41.3in.) head and body length with the tail 30.7cm (12in.) the hind foot 20cm (7.8in.) and the ear 15cm (5.8in.). Dunbar Brander (1931) states that females weigh about 4.5kg (10lb) less than males.

Very young hyaenas have softer silky hair and are more boldly marked with the body fur greyish-white and the black stripes more sharply distinct than in adults.

**Distribution and Status:** The Striped Hyaena is primarily an inhabitant of rough hilly country with broken ravines and rocky escarpments. Absent from forested areas it will occur

in mountain steppe areas up to 1820m (6000ft) in elevation in Baluchistan as well as in sand-dune areas in the Indus plains where human settlement is relatively sparse.

Formerly relatively common in Sind (Eates, 1968) it is now comparatively rare anywhere east of the Indus River. It still occurs widely throughout the broken foothill country west of the Indus, from Dadu and Larkana districts in Sind through Dera Ghazi Khan, Dera Ismail Khan and Kohat. It occurs sparsely throughout Baluchistan, Waziristan and the North West Frontier Province in remote hilly tracts and also ascends the broader Himalayan valleys. In December 1970, Schaller (pers. comm.) came across unmistakable evidence of hyaenas in the vicinity of the main town of Chitral as well as up to 3300m (11,000ft) elevation in Chitral Gol. There is no evidence of the occurrence of the hyaena in the Murree, Hills or in Azad Kashmir. In the Punjab hyaenas used to occur in the Salt Range but in the opinion of various local authorities they have now virtually disappeared from the region (H. Waite, pers. comm. and Malik Muzaffar Khan, pers. comm.). In the late 1960s hyaenas were killed on two occasions close to the Indian border between Lahore and Kasur. In 1965 a hyaena carried off a young goat from a village alongside the Chenab River in the south west corner of Multan district. This was witnessed by a wedding party of about 30 villagers (Imam Din, pers. comm.) but even before this they were considered of very unusual occurrence in the region. Hyaenas used to be plentiful in Dera Ismail Khan where it was the practice to hunt them with dogs but they are reported to be rare even in these areas. In southern Sind hyaenas still occur around the Makli Hills and Khadeji just north of Karachi. Six hyaenas were counted by Forestry officials in April 1971 in the Murri Mongthar Hills while censusing Urial.



Hyaena hyaena

Distribution Map 54 Striped Hyaena.

A few still survive in the eastern part of Khairpur State, in Takkar. It appears to be uncommon in the Kirthar Hills judging from the evidence of faecal droppings. A specimen was killed in about 1965 near Sangriaro Lake in Sanghar district of Sind.

Recent evidence from Forestry Department officials indicates that hyaenas are still not uncommon in the hill ranges around Quetta and Loralai.

In Pakistan the hyaena is now almost extinct from the Indus plain and very rare even in the remote and barren foothill regions west of the Indus. It is still of some value as a scavenger in such regions. Extra-liminally the Striped Hyaena is found from north Africa through Arabia, Iraq, Iran, Afghanistan and Trans-Caucasia to Turkestan in Russia. It extends throughout the dryer portion of India but does not occur further east in Assam or Burma.

**Biology:** Hyaenas spend the day sheltering in underground burrows or natural caves. They often take over and enlarge burrows excavated by porcupines, but are capable of excavating their own burrows. They are reputed to be capable of travelling enormous distances each night in their quest for food and to rely heavily upon scent in foraging for the same.

In Pakistan hyaenas appear to subsist principally upon bones or old carcasses which have been picked clean by vultures. They are capable of splitting the femur of a camel and can easily crush smaller bones. Besides extracting the marrow therefrom they swallow whole pieces of bone as indicated by their faeces. It would be interesting to ascertain the bearing pressure exerted by the cusps of their carnassial teeth which must be in the region of over 220lb (100kg) per square inch to perform such bone splitting feats. H. B. Waite (pers. comm.) found the remains of a porcupine in a cave inhabited by a hyaena and other writers have mentioned that they are fond of the flesh of this rodent which must be quite a difficult prey to overcome. Occasionally they will attack and kill domestic animals, usually seizing young or sick individuals, but they will demonstrate great courage at times and there are authentic instances of hyaenas driving leopards off their

kill (Pocock, 1941). Eates (1968) states that in Sind there were many instances of donkeys being killed by hyaenas. A male hyaena killed near Malir in 1966 was found to have nothing in its stomach except the remains of an old leather shoe (T. Robertson, pers. comm.). J. A. W. Anderson (pers. comm.) once surprised a hyaena at Sehwan (Dadu District), inside a railway wagon, which was filled with bones for shipment to a glue factory. He tried to corner the animal which made no attempt to attack but finally managed to jump out through the upper portion of the half closed doors. Hyaenas in Baluchistan are also known to eat the Four-toed Tortoise (*Testudo horsfieldi*) and presumably would experience no difficulty in crushing the bony carapace. It is noteworthy that a hyaena in Palestine was also observed crushing and eating a tortoise (Hatt, 1959). They will also eat fruit when available and are reported to be especially fond of the ripe berries of the Russian Olive (*Eleagnus hortensis*) in Baluchistan.

According to Dunbar Brander (1931) hyaenas are generally encountered in pairs and they probably form lasting bond relationships. Young are believed to be produced mainly in the spring and summer months though the gestation period is not clearly known. Pocock (1941) quotes Heinroth as giving a gestation period of seven months. Probably the gestation period is between 3 and 3½ months which are the known lengths for the Brown and Spotted Hyaenas respectively (Crandall, 1964). A female killed near Kasur in late February by Mr. Kreh carried two half-developed foetuses in its uterus. Champion (1927) records a litter of five young in central India. Prater (1965) gives the litter size as varying from two to six. The newly born young are blind and quite helpless, remaining in the shelter of their underground burrow or cave until more or less weaned. In captivity the Striped Hyaena has lived for 23 years (Crandall, 1964).

The Striped Hyaena is not as vocal as the Spotted Hyaena in Africa but they will emit a sort of chattering laugh as well as a weird kind of howl (Dunbar Brander, 1931). A young captive hyaena at Lahore Zoo became quite tame and exhibited marked signs of affection towards a German lady who looked after it when it was first captured. I observed that even two years later, when adult, it seemed to recognize its former mistress and approached the bars of its enclosure making peculiar whimpering cries when called. Other writers describe the hyaena as being easily tameable and making a docile and trustworthy pet (Pocock, 1941). Male hyaenas regularly scent their territory by rubbing their anal gland on protruding stones and a captive specimen has been observed to do this on the walls of its enclosure and feeding trough by a squatting motion and eversion of the sac-gland.

#### FAMILY FELIDAE – CATS

Comprising about 36 species of cats, distributed almost throughout the world this is a remarkably homogeneous family. Though varying considerably in size and fur colouration, they are generally similar in external appearance, with relatively rounded heads, short muzzles and conspicuous upstanding ears. They are characterized by a reduced number of teeth and only one true molar. Their bodies are slender and laterally compressed and in most species the tail is long. Adapted for hunting by stealth they have cushion-like pads on the soles of the feet, with five digits on the forepaw and four on the hind foot. All digits have strong curved



claws which retract into protective sheaths so that their points do not become blunted through wear.

The family has presented some difficulty in its taxonomic classification because of its homogeneity. Some zoologists consider that it should be subdivided into six or more genera. Ellerman and Morrison-Scott (1951) subdivide the family into four.

Pakistan is richly endowed with representatives of this family with possibly eleven species occurring.

### Key to the Family FELIDAE

Muzzle shortened (about one-fifth of total skull length). Tooth row of lower jaw with conspicuous gap behind canine, and only four or three teeth behind the canine in each jaw (see Fig. 44). Four toes on hind feet. Claws retractile. No scent glands near the anus.

### Genus FELIS Linnaeus, 1758

Size generally rather small with tail relatively long. Generally nocturnal in activity. Claws retractile into horny sheaths.

### Key to the Pakistan Species of FELIS

- (a) Pelage spotted all over. . . (c)
- (b) Pelage unspotted except possibly showing faint spots in region of lower flanks and elbow. . . (d)
- (c) (i) Back of ears sandy-buff  
    . . . *Felis libyca*
- (ii) Back of ears black with round whitish spot in centre. Tail more than half head and body length. Slender build and small size with head and body length 54cm.  
         . . . *Felis bengalensis*
- (iii) Back of ears black with round whitish spot in centre. Tail less than one-half head and body length. Thick set body and medium size with head and body length 74cm.  
         . . . *Felis viverrina*
- (d) Pelage unspotted.
  - (i) Size medium large with ears having apical hair tufts. . . (e)
  - (ii) Size small with ears angled outwards and set wide apart on crown. . . (f)
- (e) (i) Size medium large. Head and body length 89–107cm. Tail very short (less than one-seventh head and body length) terminating in black tuft. Paws comparatively large and spine relatively short.  
    . . . *Felis lynx*
- (ii) Size medium large. Head and body length 70–76cm comparatively longer tail (about one-third head and body length) and uniformly coloured. Backs of ears entirely black or with frosting of white hairs. No black stripes on inside of fore-legs.  
        . . . *Felis caracal*
- (iii) Medium size. Head and body length 64–72cm. Tail about one-third head and body length terminating in a black tip preceded by 2 or 3 black rings in the distal portion. Back of ears reddish-chestnut with inconspicuous apical hair tufts. Black horizontal stripe on inside of fore-legs.  
        . . . *Felis chaus*
- (f) (i) Small size. Head and body length 45–50cm with forehead unspotted but showing faint vertical

reddish-brown stripes. Chest creamy-white. Pads of feet concealed by long greyish brown hairs.

. . . *Felis margarita*

- (ii) Small size, head and body length 45–51cm. Forehead with scattered black spots, chest greyish-black. Pads of feet naked.

. . . *Felis manul*

### FELIS LIBYCA

*Felis libyca* Forster, 1780; African Wild Cat (see Illustration 37).

Subspecies *Felis libyca ornata* Gray, 1830; Indian Desert Cat. Synonym *Felis constantina ornata* Gray, 1832.

**Taxonomy:** *Felis libyca* is now considered by many zoologists to be conspecific with *Felis sylvestris*. Some authorities even consider that all domesticated cats are directly descended from *Felis libyca* and that *Felis catus sylvestris* Shreber, 1777 should be considered as a synonym for both *Felis sylvestris* and *Felis libyca* (see, for example, Schwarz, 1930; D. C. Harrison, 1964; Lay, 1967; and Van den Brink, 1967).

Most populations of domestic cats in Africa and the Middle East will freely interbreed with wild cats and there is no doubt that *Felis libyca* shows great variation in pelage pattern throughout the Middle East. The actual taxonomic position may well be that European, African and Middle Eastern populations of *F. sylvestris* and *F. libyca* are inseparable in overlapping parts of their range but certainly the Pakistan population of *Felis libyca* is very distinct from the wild cat of Africa as well as *F. sylvestris tristrami* which is similar to the wild cat of western Europe with its bushy tail and tabby-like markings. Recent Russian publications also recognize two populations of wild cats. One east of the Caspian with a spotted pelage they refer to as *F. libyca* and the other west of the Caspian Sea with faint vertical body stripes and a more bushy tail, is referred to as *F. sylvestris* (Flint et al., 1965 and Bobrinskii et al., 1965).

**Description:** In Pakistan *F. libyca* is a relatively small cat though slightly bigger than *F. margarita*. The average of four specimens had the head and body length 497mm (19½ in.) (range 470–542mm (18½–21¼ in.)) with the tail 241mm (9½ in.) (range 219–290mm (8.6–11.4 in.)), the hind foot 132mm (5.2 in.) (range 121–145mm. (4¾–5¾ in.)) and the ear 59mm (2.3 in.) (range 55–66mm (2.15–2.6 in.)). A large male captured near Ghizri Creek in Sind stood about 30.5cm (12 in.) at the shoulder and weighed 4kg (8.8 lb).

The general body colouration is pale sandy-yellow covered with rather small and clearly separated greyish-black spots. These spots tend to lie in vertical lines down the trunk and flanks. The tail which is not particularly thick or bushy is spotted in its proximal half with four or five black rings in its distal half. There are small scattered spots around the paws with one broad black ring on the inside of the elbow of the fore-paws. The lower surface of the paws is clothed with black fur. The belly fur in winter is long and soft and creamy-white with a few indistinct black spots. The head shows small scattered spots on the forehead in contrast to the vertical stripes on the forehead of *F. sylvestris* or *F. bengalensis*. The backs of the ears are yellowish-buff or khaki with darker tips and very small black apical tufts in adults. The prominent white vibrissae measure up to 60mm and the eyes vary from greenish-grey to amber in colour. There is considerable individual variation with some specimens having a more

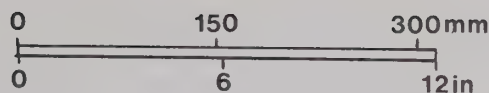


Illustration 37 *Felis libyca*: Desert Cat. (Based on fresh killed adult male specimen from near Jhangshahi.)

greyish ground colour to the body fur and others having much heavier spotting. Heavily spotted specimens have been collected from the mountainous border regions of western Sind.

A pair of this species from Africa, exhibited at Paignton Zoo in 1970 were much larger than any Pakistan specimens seen by me and had a greyish-fawn body colour with indistinct vertical body stripes in sharp contrast to typical Pakistan specimens described above.

**Distribution and Status:** This wild cat is strangely local in occurrence, being entirely absent from the alluvial plains as well as more populated cultivated tracts. It extends sparsely through the desert regions of Tharparkar and up through the dryer hilly regions on the west bank of the Indus. It appears to be absent from higher mountainous regions and has not penetrated into the northern Himalayan areas even in the valleys. It is relatively common in Thatta District, Tharparkar, Dadu and Larkana Districts of Sind. It occurs very rarely in Cholistan and a specimen was collected from Fort Abbas by a University of Maryland expedition. It occurs in Dera Ismail Khan District, in the Thal District and throughout the Salt Range. Specimens have been collected from Wana in southern Waziristan and also from southern Kalat but there are no specimens from the higher mountain regions of Baluchistan. In India *F. libyca* has been collected in Rajasthan and Kathiawar but not further east. The Street Expedition encountered it in all parts of Iran, except the extreme north (Lay, 1967). It occurs in the dryer parts of Asiatic Russia and the Bombay Natural History Society has two fine specimens from Ladakh and eastern Afghanistan. *F. libyca* occurs over most of Africa except the tropical equatorial region and

spreads through Arabia, Iraq, the Lebanon and Afghanistan (Ellerman and Morrison-Scott, 1951).

This small cat is comparatively rare and local in distribution in Pakistan. Its luxuriant soft fur with handsome pattern makes it valuable to the fur trade and large numbers of pelts are regularly purchased by fur traders in Rawalpindi and Peshawar.



*Felis libyca ornata*

Distribution Map 55 Indian Desert Cat.



**Biology:** Adapted to semi-desert regions and areas of barren low hills, this cat finds shelter by burrowing. It is capable of excavating its own burrow system which often has two or more escape holes. In rocky areas it tunnels under boulders and may utilize natural caves if these offer suitable shelter. It shelters underground during the heat of the day and usually does not emerge to hunt until dusk.

Though subsisting principally on desert rodents this resourceful cat can subsist on insects if nothing better is available and also reptiles form an important part of its diet particularly in the summer season when most reptiles emerge to feed in the cool of the night. The remains of Spiny-tailed Lizards (*Uromastix hardwicki*) were found in a burrow of this cat which contained young kittens (J. A. W. Anderson, pers. comm.). The stomach contents of three specimens from Rajasthan (India) were reported by Prakash (1959A) to contain the remains of *Meriones hurrianae*, termites and cockroaches (*Periplaneta* spp.), beetles (*Anthia sexguttata*) and crickets (*Gryllus saggilatus*). Another had feathers of *Columba livia*, the remains of *Tatera indica*, unidentified beetles and, surprisingly, leaves of *Prosopis spicigera* in its stomach. In Kathiawar (India) another was observed feeding on carrion (Bombay Natural History Society, Report No. 10, 1913). A male was killed in 1969 at Kundian in Mianwali District while attempting to attack and kill domestic chickens (Savage, pers. comm.), and Eates (1968) mentions the predilections of this cat in Sind for raiding domestic poultry pens. They are undoubtedly able to kill snakes and probably successfully hunt Desert Hares (*Lepus nigricollis*) as well as capturing birds and rodents.

Like most of the *Felidae* there is no lasting pair bond and the female alone cares and feeds her young. Females are

sexually mature at about ten months of age and in southern Sind they appear capable of breeding at all seasons of the year. The gestation period is 56 days and litter sizes appear to be generally rather small with two or three kittens being usual. Young kittens of this species when captured appear to be more intractable and fierce than the kittens of *Felis chaus*. They remain well concealed in an underground nest chamber until they are practically weaned.

Feral and domestic cats in the vicinity of both Karachi and Mianwali where *F. libyca* occurs, often show an almost identical body colouring and pattern of spots, and hybridization between this wild cat and domestic individuals appears to occur quite commonly.

*F. libyca* in Africa is recorded as having a harsh 'meow' (Dorst and Dandelot, 1970). Like all the *Felidae*, males lack perineal scent glands, but mark their territory by squirting urine onto tufts of grass or the tops of stones. Captive specimens of this species from Africa have lived for 16 years (Crandall, 1964).

### FELIS CHAUS

*Felis chaus* Güldenstaedt, 1776; Jungle Cat, known as the Swamp Cat in Africa and the Reed Cat in Russia (see Illustration 38).

Subspecies *Felis chaus prateri* Pocock, 1939.

**Description:** Considerably larger than Pakistan specimens of *Felis libyca*, this cat is also distinctive in having relatively longer legs, close set and longer ears and a relatively short tail. Its body is also unmarked by spots being of a uniform reddish-buff or tawny-grey colour.

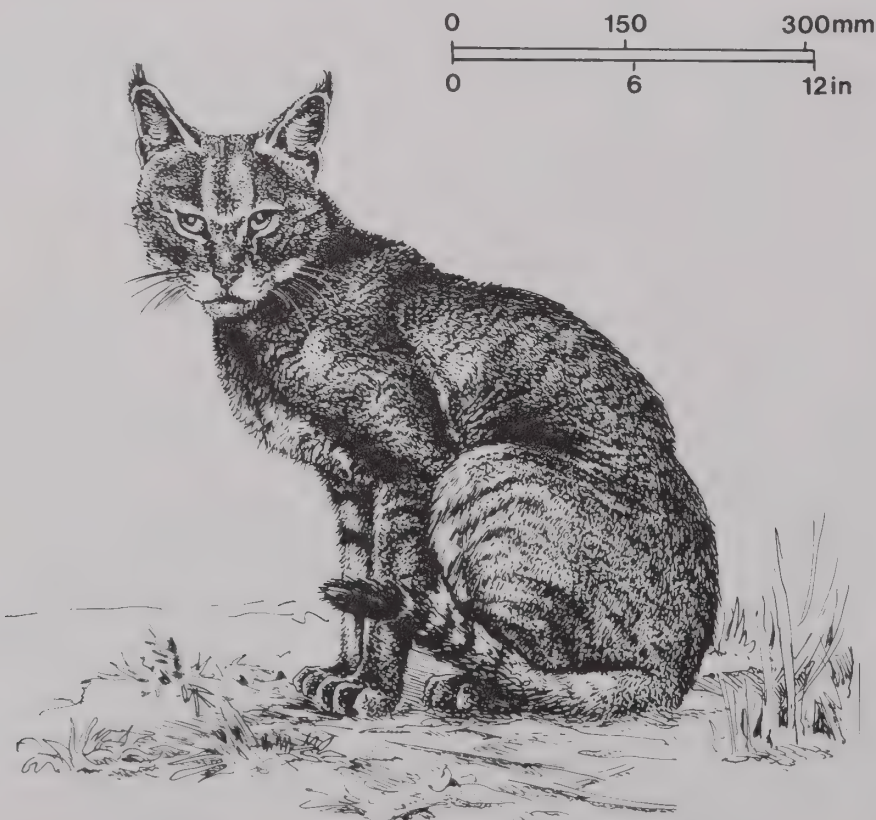


Illustration 38 *Felis chaus*: Jungle Cat. (Based on live captive specimen, adult male from Chashma, Mianwali District, Punjab.)

The fur is somewhat harsh in summer coat and the individual hairs are dark tipped, being reddish-buff basally. The belly fur is pale cream or fulvous and comparatively long and soft in winter coat. There is some individual variation in the colour with specimens from the desert regions of southern Sind being more rufescent and specimens from the northern Punjab having greyer tones. The tail is generally about one-third of the head and body length and looks shorter than that of a typical domestic cat. The distal one-third of the tail bears two or three rather narrow and distinct black rings terminating in a solid black tip. The inside of the fore-legs bear two prominent black rings. Generally the rest of the body lacks any distinct markings though traces of indistinct vertical reddish-brown stripes run down the crown towards the muzzle. The outer surface of the fore-legs shows four or five faint reddish-brown rings. The facial expression can only be described as mild compared to many other wild cat species. The naked rhinarium is brick coloured and the iris yellow. The long ears are rounded and set close together on the crown. Their backs are reddish-buff with a distinct black apical tuft of hairs which may be up to 15mm (0.6in.) in length. The muzzle and throat are usually white or ochraceous and the area around the eye is whitish with a dark line running from the corner of the eye down each side of the nose.

The subspecies *Felis chaus prateri*, of which the type specimen comes from northern Sind, is distinguished by its more tawny hue and larger size when compared with other populations (Pocock, 1931). Certainly specimens from Pakistan average larger than those from central or peninsular India. A female from the Punjab had the head and body measuring 618mm (24.1in.) with the tail 256mm (10in.) and the hind foot 143mm (5.6in.) and the ear 74mm (2.9in.). A large male shot near Abdul Hakim measured 803mm (31½in.) head and body length with the tail 250mm (9.8in.), the hind foot 153mm (6in.) and the ear 67mm (2.65in.). This exceptionally fine specimen weighed 9kg (19.8lb) and was the largest I have ever seen.

In Tharparkar and Thatta districts of Sind a handsome melanistic form regularly occurs. Pocock (1939) refers to one specimen from Karachi which was 'silver and black' which he assigned to the subspecies *F. chaus prateri*. Similar skins still come into the hands of Karachi furriers.

**Distribution and Status:** This is the most widely distributed and adaptable of the smaller cats inhabiting Pakistan. As its common name indicates in Africa and Central Asia, it is particularly associated with riverine swamps and reed beds. In Pakistan it can be encountered in extensive sand-hill desert, barren hilly country at low elevations as well as in the fertile cultivated plains of the Indus. Whilst favouring riverine thickets or irrigated forest plantations it will also inhabit relatively open and barren areas with the sparsest of scrub cover. It avoids only higher mountain regions.

In Pakistan it is widespread and relatively common throughout the Punjab and Sind provinces including the Thal and Cholistan deserts. It occurs less commonly throughout southern Baluchistan and the North West Frontier Province at lower altitudes. It does not appear to have penetrated in the north west Himalayan regions though it occurs in the main vale of Kashmir outside of Pakistan territory (Pocock, 1939). It occurs very rarely in Quetta Valley, frequenting river thickets and it has been shot in the Lora Nullah in the late 1960s (Arbab Yahya, Forest Ranger, pers. comm.).

The Jungle Cat is sympatric with *F. libyca* in southern Sind as well as Mianwali District and since it is more plenti-



*Felis chaus* [hatched box] Known distribution  
[stippled box] Probable range

Distribution Map 56 Jungle Cat.

ful than the latter species its ecological requirements appear to be less exacting and it is certainly well able to hold its own in areas of human settlement. Though it will kill game such as partridges and hares it is of more benefit than harm since it feeds principally on rodents.

**Biology:** The Jungle Cat is not as strictly nocturnal as *F. libyca* and may often be seen emerging to hunt in the late afternoon. Though it will shelter in underground burrows especially during the summer months it is not so dependent on burrowing as *F. libyca* and will lie up by day in thickets of grass and thorn scrub. In desert areas however, they will enlarge or excavate underground burrows in which they shelter during the hotter part of the day. In winter time it is not uncommon to encounter this cat sitting and sunning itself out in the open. A captive specimen provided with a covered shelter, which I kept at Khanewal, regularly sunbathed until the end of March. After this date it appeared to find the sun too strong and did not emerge to sun itself.

With its long legs, the Jungle Cat is capable of running at great speed but normally it captures its prey by stealth. They are known to hunt all kinds of small birds and rodents but will tackle much larger prey when opportunity avails. Also they are capable of subsisting on insects and reptiles when other food is not available. Three specimens collected in Afghanistan had the remains of the common House Mouse (*Mus musculus*), the Mole Rat (*Nesokia indica*) and frogs (*Rana ridibunda*) in their stomachs (Niethammer, 1966). A specimen collected in Rajasthan (India) had the remains of the Desert Jird (*Meriones hurrianae*) and the Dung Beetle (*Heliocopris*) in its stomach (Prakash, 1959A). Eates (1968) recounts finding a Jungle Cat entwined by a Cobra (*Naja naja*) in Sukkur District, both lying dead and showing signs of a fierce fight. The Jungle Cat probably avoids larger more dangerous snakes but it will successfully overcome and eat smaller snakes such as the Common Racer (*Coluber ventromaculatus*) as well as Spiny-tailed Lizards (*Uromastix* spp.). A Jungle Cat entered a high-walled enclosure where captive gazelle were kept and succeeded in killing and partly devour-



ing two sub-adult gazelle (*Gazella gazella*) before it was finally trapped (Lt. General J. H. Marden, pers. comm.).

Litters in Pakistan appear to be usually born in the winter or early spring and the gestation period is about 56 days. An experienced Sind animal trapper belonging to the Jogi caste, who had often captured litters of this cat informed me that three or four were the usual litter size. A lactating female was killed in late March in Pirawala Forest Plantation. In February a family of three kittens was found in a dense reed bed at Marala. A raised nest platform lined with fur and soft grasses had been constructed and the remains of a Striated Babbler (*Turdoides earlei*) was found beside the kittens (E. Fernando, pers. comm., 1968). Ognev (1935) also states that this cat commonly produced its kittens in a dense reed bed but specimens from Sind have been dug out of an underground burrow. According to Sterndale (1884) the Jungle Cat often produces two litters per year. Young kittens have their bodies faintly marked all over with dark scattered spots and the backs of the ears are a bright rufous colour. The kittens seem docile and can be handled. A captive specimen lived nine years (Dover, 1933).

Generally this cat lives singly, but I have watched a pair stalking a hare (*Lepus nigricollis*) in Pirawala Forest Plantation and they were both adults. According to Ognev (1928) they can climb trees well though probably seldom do so. Because of its long legs it moves quite swiftly even when trotting unhurriedly. In Iraq a specimen was clocked running at 32km/hr (20 mile/hr) (Hatt, 1959). A male specimen held captive at Khanewal for some months sometimes called in a rather weak high pitched cry repeated 6 to 10 times in the early hours of darkness. This was probably a mate attracting call. Even when threatened it would not spit whereas a young captive *F. libyca* regularly emitted spitting cries when approached too close.

## FELIS MARGARITA

*Felis margarita* Loche, 1858; Sand Cat or Dune Cat (see Illustration 39).

Synonym *Eremaelurus thinobius* Ognev, 1926.

**Description:** Smaller than either of the two previous species (*F. libyca* and *F. chaus*), this cat is highly adapted to desert conditions. Its general conformation is similar to *F. libyca* with a relatively long tail and short legs. The skull however, appears broader than that of *F. libyca* and the ears are very low set and wide apart on the crown giving the animal a very characteristic appearance when viewed from in front.

The general colouration is very similar to that of *F. chaus* though there is more white about the lower muzzle and chest and the upper part of the body is more ferruginous. The distal one-third of the tail bears two or more thin black rings and the terminal tuft is black. The fore-legs have 4 or 5 faint dark brown stripes on the upper part of the outside of the limb with one thick black band around the inside near the elbow. A striking feature about this cat is the pads of the feet which are entirely covered with long greyish-black hair. This is believed to be a valuable adaptation in travelling over soft sand. The body has soft dense fur even in summer coat and there are often faint traces of thin dark stripes running vertically across its trunk with several indistinct thin horizontal stripes across the lower flanks. The fur on the belly and chest varies from pale cream to almost pure white as well as around the throat and lower cheeks. Sometimes there are white patches about the fore feet. The rhinarium is very dark brown, almost black, with the iris greenish-yellow. There are prominent reddish-brown stripes radiating from the outer corners of each eye. The ears are more pointed than those of *Felis manul*,

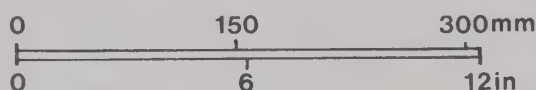


Illustration 39 *Felis margarita*: Sand Cat or Dune Cat.  
(Based on live captive specimen in possession of J. A.  
W. Anderson, adult male from Nushki, Baluchistan.)

but very similar being widely spaced and pointing outwards from the crown rather than vertically. The backs of the ears are reddish-buff with conspicuous black tips but no apical tufts and the insides of the ears are thickly fringed with white hairs.

Besides the long curly hairs covering the soles of the feet this cat has developed greatly enlarged tympanic bullae under the skull, both features are typical of other psammophylic mammals (see Chapter 3).

An adult male specimen captured at Nushki had the head and body measuring 57cm (22½in.) with the tail 28cm (11in.), the hind foot 11.8cm (4.7in.) and the ear 7.4cm (2.9in.). Females are smaller than these measurements.

**Distribution and Status:** The only area in Pakistan where this cat has been found comprises high rolling sand-dunes interspersed by flat stony plains at about 1200m (4000ft) elevation in an area of extreme aridity. In Russian Turkistan it has been described as inhabiting sand-dune areas (Ognev, 1935) but in Arabia it has also been found in stony desert (D. L. Harrison, 1968).



Distribution Map 57 Pallas's Cat.  
Sand Cat or Dune Cat.

The existence of this cat in Pakistan was discovered by J. A. W. Anderson, who had a male specimen brought to him after it had been captured on 27 July 1966 from a burrow in the embankment of the Lora River 16 miles north west of Nushki. Subsequently five more females including two sub-adult and three males were captured from the same region in September of 1966. These were exported to various zoos. Its presence has now been confirmed in areas further west in the Chagai plateau.

This cat inhabits such inhospitable desert regions that it has rarely been encountered by zoologists and little is known about its actual world distribution. It was first discovered in the Sahara by a French expedition in 1910. When it was first collected by Russian zoologists from the Karakum Desert of

Turkmenia it was described as a new species, *Eremaelurus thinobius* (Ognev, 1935). There was no other evidence of its distribution beyond these two widely separated discoveries until a specimen was collected in Arabia in 1950 by Thesiger (D. L. Harrison, 1968).

The discovery of the Sand Cat in south western Baluchistan fills an important gap in its known distribution (Lay et al., 1970). There is an unconfirmed report of its existence in the environs of Teheran, Iran (Lay, 1970). It has not been found yet in Afghanistan nor in any other part of Baluchistan.

Because of its rarity there is a keen demand from zoos for this cat and nine specimens were exported from Baluchistan in the autumn of 1972.

Since its total world population is so restricted and it is of great zoological interest the Sand Cat in Pakistan should be totally protected from all trapping and export.

**Biology:** Like *Felis libyca*, this cat also digs its own burrow and escapes the summer heat by remaining underground during the day. One such burrow excavated in Nushki was 4½m (15ft) in length and was 14cm (5½in.) wide at its mouth. Their burrows invariably have only one entrance.

Despite the extreme aridity and relative barrenness of its habitat, there is a plentiful supply of food for this cat, in the regions around Nushki, where it occurs. Rodents such as *Gerbillus cheesmani* and *Meriones libycus* are abundant, also Sand Geckos (*Teratoscincus* spp.) and Snakes (*Eryx* spp.). According to the jogi (animal trapper) who has successfully captured this cat, there was evidence from its tracks that it several times unsuccessfully chased Blanford's Jerboa (pers. comm., 1966). This is certainly not surprising considering the agility of this rodent. Captive specimens in the possession of J. A. W. Anderson readily consumed lizards. In the Turkmenia plains of Russia this cat was found to subsist mainly on Jirds (*Rhombomys opimus*) and Jerboas (*Dipus* and *Allactaga* spp.) (Ognev, 1935). These cats often live in areas where there is no water so that they must be able to obtain all their fluid requirements from their prey. A captive specimen drank water freely however.

In Baluchistan these Sand Cats appear to produce litters in the spring and also late summer and they may well be capable of breeding twice a year (J. A. W. Anderson, pers. comm.). Kittens have been found in March and April. Another litter was captured in early October when estimated to be about six weeks old. Ognev (1935) records the capture of this cat in south eastern Karakum Desert in the USSR, a female which gave birth to four kittens on 9 April shortly after capture. March and April are the months of optimum vegetative growth in Baluchistan and many desert rodents breed also at that season. Litters in Baluchistan have comprised either two or three young. One such discovered on 18 March 1968 was removed by the mother to a safer hiding place when J. A. W. Anderson (pers. comm.) returned the next day to excavate it. They were estimated to be about three weeks old at that time.

The Sand Cat is believed to be strictly nocturnal throughout most of the year but may emerge on the surface to sunbathe in winter. A freshly captured male was observed to spit and growl in the typical manner of a domestic cat when closely approached. Its most striking characteristic was the way in which it would flatten its ears till they were almost hidden in the cheek ruffs, whenever approached. This accentuated the broadness of its face. J. A. W. Anderson who has kept specimens for periods of two and three months once heard an adult male calling at dusk. It emitted a rapidly repeated harsh cry which syllable-ized as 'yea-yea-yea'. This may have been a mate attracting call.



Subgenus **OTOCOLOBUS** Brandt, 1841

## FELIS MANUL

*Felis manul* Pallas, 1776; Pallas' Cat or Steppe Cat (see Illustration 40).

Subspecies *Felis manul nigripecta* Hodgson, 1842  
and *Felis manul ferruginea* Ognev, 1928

**Description:** Pallas's Cat appears to occur in two very distinct forms within Pakistan territory though recent reliable records are lacking.

The subspecies *Otocolobus manul nigripectus* described from Ladakh and Tibet is similar to the nominate subspecies which occurs in central Asiatic Russia except for being more silvery-grey in winter coat. The subspecies *F. manul ferruginea* is an erythristic form.

About the size of a large domestic cat, Pallas's Cat has very thick dense soft fur of a grizzled or silvery buff tone. The longer guard hairs are alternately banded with black and cream. The comparatively long tail is noticeably thick and rounded having a broad black terminal tuft preceded by five or six narrow black rings throughout its length. The rest of the body is unmarked except for faint traces of three vertical black stripes in the region of the lower back and two prominent dark stripes running horizontally around the inside of the fore-legs. The face is also strikingly patterned. The forehead and crown is silvery-grey with scattered black spots. There are two parallel black stripes radiating downwards from the outer corner of each eye. The first or inner stripe frames the lower margin of the eye itself. The backs of the ears are buff without black tips and are very characteristic in outline being rounded and set wide apart, on each side of the crown rather

than on top of the head. The rhinarium is pinkish-brown and generally the chin as well as the upper throat are pure white. The fur on the chest and belly is particularly long and silky and tends to be dark-grey or blackish in colour. The fur on the under surface of the paws is reddish-buff. A specimen from Russia in Regents Park Zoo seemed to have long tactile hairs all over the forehead as well as the upper cheeks. The broad forehead with low set rounded ears and speckled markings around the eye impart a particularly malevolent look to its face.

In specimens of *F. manul ferruginea* the whole pelage is rich orange or ginger colour and darker reddish-chestnut spots can be discerned on the forehead as well as darker reddish rings around the tail. There are usually faint horizontal stripes also discernible around the upper part of the fore-arms. Usually three or four faint vertical stripes are also discernible running across the rear part of the back and extending vertically down the flanks. In both these races in winter coat there is a thick under-wool.

According to Pocock (1939) specimens from Ladakh had the head and body length averaging 51.9cm (20.45in.) whilst specimens from Baluchistan were slightly larger with the head and body length 63.6cm (25in.) and the tail 29.4cm (11½in.). According to Ognev (1928) the weight of typical *F. manul* from Russia is 2.7–3.4kg (6–7½ lb).

**Distribution and Status:** The existence of Pallas's Cat in Baluchistan is undisputed. A specimen was collected from the Toba Kakar Hills north of Hindu Bagh in 1910 which is in the British Museum collection. This is the erythristic form. Another red specimen was presented to Quetta Museum and collected near Ziarat (Pocock, 1939). J. A. W. Anderson (pers. comm.) while trapping pikas (*Ochotona* spp.) on the upper slopes of Mount Kaliphat encountered a specimen of this

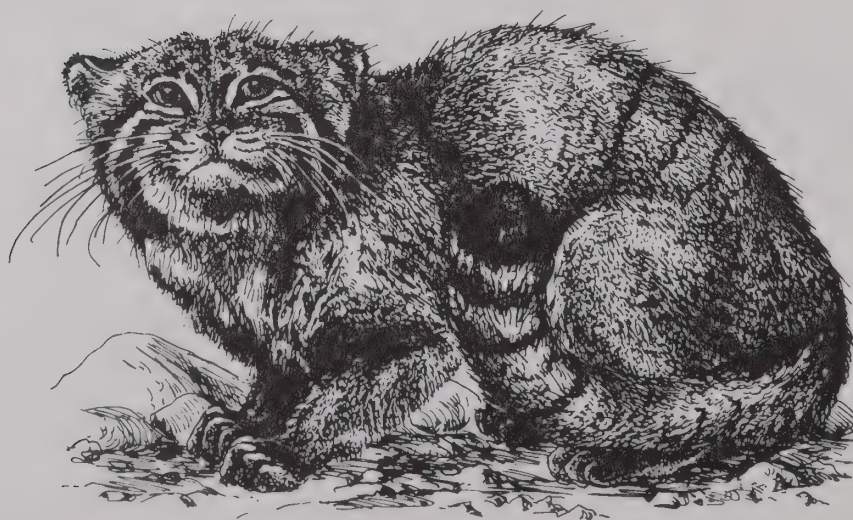
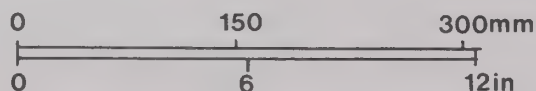


Illustration 40 *Felis manul*: Pallas' Cat. (Based on study specimen in British Museum collection from Ladakh and live captive specimen Regents Park Zoo from USSR.)

cat in a cave at about 3300m (10,700ft). This specimen managed to avoid capture. Arbab Yahya, Forest Ranger, claimed to have seen this cat in early 1960s while patrolling in the Zarghun mountains. There is no evidence that this steppe cat occurs in the lower hills of southern Baluchistan nor are there any records of its occurrence in the north towards Waziristan. It is however known to occur in Afghanistan and according to Mr. Kuhnert of Kabul Zoo, Pallas's Cat is not uncommon in the vicinity of Kabul. Ognev (1928) first described this red form in the Trans-Caucasian region of Russia and believed that it extended into northern Iran. (See Distribution Map 57.)

The subspecies *O. manul nigripictus* has been collected in Ladakh in regions adjacent to Baltistan but there is no definite evidence of the occurrence of this species in Baltistan. However fur traders and hunters in Chitral have informed me that a small cat with a thick and valuable fur is known from the extreme northern region of Chitral State near Baroghil. Their description of this animal would seem to correspond with *Felis manul* and it is noteworthy that these traders were able to differentiate this cat from *F. lynx* and *F. bengalensis*. This is however highly circumstantial evidence and awaits confirmation.

Extra-liminally, Pallas's Cat extends from the shores of the Caspian Sea eastwards to Lake Baikal and southwards throughout Asiatic Russia and Tibet.

Whitehead purchased a skin of *F. manul ferruginea* in Peshawar which is said to have come from Afghanistan and this specimen also exists in the British Museum collection.

Whether *Ferruginea* is a distinct subspecies or simply an erythristic mutant remains to be determined if ever more specimens can be collected, but the Baluchistan population of this cat is certainly very sparse and confined to the higher mountain regions. In such regions it is associated with stunted *Juniperus macropoda* steppe forest. In Ladakh it is associated with barren stony valleys and hill ranges above the tree line from 3600m (12,000ft) up to 4800m (16,000ft).

**Biology:** Practically nothing has been recorded about the habits of this cat and they do not appear to have bred anywhere in captivity.

In Ladakh they apparently hunt diurnally in areas where pikas (*Ochotona* spp.) are their main prey (Stockley, 1936). The specimen encountered in a cave in Baluchistan had been feeding on Chukor (*Alectoris graeca*) according to the evidence of feathers and it is probable that these Rock Partridges form an important part of their diet in Baluchistan (J. A. W. Anderson, pers. comm.).

Observations from the few specimens of this cat which have been kept in zoos indicate that it is inclined to be aggressive and fearless of man. A specimen at Regents Park Zoo attempted to attack its keeper (Dr. D. Brambell, pers. comm.). When approached it apparently does not spit like small cat species according to Ognev (1935) and it is normally silent. Once a male specimen called when excited, and this was a noise more evocative of the yelping of a small dog rather than the meow call of a cat (Ognev, op. cit.).

#### Subgenus LYNX Kerr, 1792

Distinguished from the subgenus *Caracal* by the relatively shorter tail (approximately one-seventh of the head and body length) and ears having a greyish-white circular patch on their dorsal surface.

#### FELIS LYNX

*Felis lynx* Linnaeus, 1758; Lynx  
Subspecies *Felis lynx isabellina* Blyth, 1847; Himalayan Lynx (see Illustration 41).

**Description:** Considerably larger than any of the species of wild cat hitherto described, the Lynx falls into a group of medium sized cats which includes the Serval, Caracal and Temminck's Cat.

In general appearance the Lynx is notable for its relatively short back, with thick powerfully developed legs, and a very short tail. The tail terminates in a broad black tip with no black rings above it. The skull is broad and the pointed ears bear prominent apical tufts of hair and the lower cheeks are fringed by especially long grey and white hairs. The general colouration of the winter coat is silvery-grey with the longer guard hairs being white tipped. There is a dense woolly undercoat of a warm ginger-buff colour which imparts a reddish tone to the whole pelage in some individuals. The shorter summer coat has less silvery tones and tends to be more reddish-buff. In adult specimens in winter coat there are usually faint traces of darker brown spots on the outside of the upper portion of the limbs as well as around the forehead. In sub-adult specimens and in summer coat these spots are more conspicuous, extending up to the lower flanks.

The Himalayan subspecies, *F. lynx isabellina*, is distinguished from the northern boreal zone population inhabiting Russia and Canada, by its paler isabelline pelage generally lacking a distinct pattern of spots, by its slightly smaller size and the fact that the pads of the feet remain exposed even in winter. The Canadian Lynx has the soles of the feet entirely covered by hair in winter whilst the ruff of longer hairs below the cheeks show a conspicuous pattern of white and black vertical streaks. These features are absent in the Himalayan population. The ears of the lynx are not particularly long in proportion to the massive broad skull. Their tips are black as well as the apical tufts which measure from 45–73mm (1.75–2.8in.) in length in several specimens from the Himalayas (Pocock, 1939). As mentioned above there is also a greyish-white circular patch in the middle of the dorsal surface of the ear. There is a faint dark stripe radiating outwards from the corner of the eye. An immature specimen from Nagar in Gilgit shows a conspicuous pattern of elongated black spots all over the body, not very dissimilar to the Caucasian form *F. lynx dinniki* (Satunin, 1915 in Ognev, 1935). This skin is in the British Museum collection.

Col. Ward (1923) gives the measurements of a typical specimen from Kashmir as 86.5cm (34in.) head and body with the tail 20.25cm (8in.) long. This specimen weighed 25kg (55lb). Pocock (1939) quotes Blanford stating that the weight may be up to 27.2kg (60lb) but it seems likely that both these figures were estimates and on the high side. An adult specimen from Asiatic Russia normally weighs about 16kg (35lb) according to Ognev (1935) though Siberian specimens have been killed weighing up to 32kg (70lb). Similarly, the maximum weight recorded for a Canadian Lynx (*Lynx canadensis*) is 16.3kg (36lb) and 10kg (22lb) is considered a typical weight (Cowan, 1965). Although the Canadian Lynx has up to now been regarded as a separate species it is probably conspecific with *Felis lynx* according to many authorities (Walker et al., 1964). The Canadian Lynx certainly averages larger in size than specimens from the Himalayas and Pakistan. An exceptionally fine male specimen from Bunir in Chitral measured head and body 103cm (40½in.), tail 22.5cm (8¾in.) and was estimated to have stood approximately 50cm (19.6in.) at



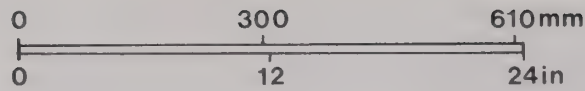


Illustration 41 *Felis lynx isabellina*: Himalayan Lynx.  
(Based on skin, adult male specimen from Baroghul, Chitral and study specimens from Gilgit, in British Museum collection.)

the shoulder. Females are equal in size to males according to measurements given for Canadian and Russian populations (Cowan et al., 1965 and Ognev, 1935).

**Distribution and Status:** The lynx in Pakistan is associated with alpine slopes above the tree line in mountainous areas as well as upland valleys in the extreme northern regions where the rainfall is comparatively low. In contrast to the European and North American populations, it is therefore not a forest dwelling animal though it is subject to local migrations, ascending in summer to the highest alpine slopes up to 4200–4500m (14,000–15,000ft). It avoids very steep rocky areas seeming to prefer regions where there is some scrub vegetation particularly reed beds and tamarisk and willow thickets in the remoter valleys.

It appears to be comparatively uncommon and very thinly distributed throughout the northern regions of Chitral and inhabiting most districts of Gilgit as well as Baltistan. In Chitral most trade skins come from around Brughal and Bunir. In Gilgit specimens have been collected from Nagar, Rostan, Ishkoman and Yasin. It probably occurs in the Indus Kohistan region and extends into the northern alpine region of Hazara District. A local shepherd was offering for sale a lynx skin killed near the Babusar Pass in 1965 (W. MacFadzean, pers. comm.). The lynx is known to the local inhabitants in Hunza and Baltistan but according to their accounts it is considered uncommon even in these remote northern regions.

Extra-limitally, the Himalayan lynx extends through Outer Mongolia, the Tienshan Mountains and the Russian Pamirs (Ognev, 1935). It seems to be confined mainly to Tibet, Ladakh and the western part of the Himalayan range in India

(Prater, 1965). The nominate subspecies extends throughout the Tundra and Boreal zones of Europe and North America.

The fur of the lynx is highly prized by traders in Peshawar and Rawalpindi, being soft and dense in texture. In 1967 a raw skin in Chitral fetched Rs.200/- (£17.00).



*Felis lynx* (at suitable altitudes)

Distribution Map 58 Lynx.

Since it is very limited in distribution in Pakistan and appears to be comparatively rare it is hoped that trade in its skin will be legally restricted.

**Biology:** Like most carnivores living in high mountain areas it is not strictly nocturnal and may emerge to hunt in the late afternoon. They shelter by day in some natural hollow or cave between rocks but in winter they are fond of lying on some exposed rocks to sunbathe by day. They are normally solitary and in Europe and Russia have been observed to hunt more by scent than do other cats. They have acute vision and hearing but have often been observed following tracks with nose to the ground (Ognev, op. cit.).

A stealthy and resourceful hunter the Himalayan Lynx is believed to be capable of preying upon a variety of animals from younger Ibex (*Capra ibex*) and Markhor (*Capra falconeri*), to small rodents such as Grey Hamsters (*Cricetulus migratorius*). They no doubt succeed in catching Rock Partridges (*Alectoris graeca*), Snow Cocks (*Tetraogallus himalayensis*) and Snow Pigeons (*Columba leuconata*) all of which share the same habitat. The lynx from Ladakh was described as feeding mainly on pigeons and Cape Hares (Lydekker, 1911). In summer they probably hunt the Long-tailed Marmot (*Marmota caudata*) which forms a more easily available food supply and in winter they are believed to hunt the Cape Hare (*Lepus capensis*). In the summer months, when there is no snow cover, it can also obtain voles (*Alticola* spp.) and all kinds of small bird species, must be killed when the opportunity avails. According to the report of local hunters in Chitral they do occasionally break into sheep and goat pens and take young animals.

According to observations in the U.S.A. (Giles, 1969) and Russia (Ognev, 1935) the lynx occasionally hides or partly buries its prey if this is a large animal and cannot be consumed at one time. This characteristic does not seem to be exhibited by any of the other medium or small sized *Felidae*.

Reproductive data on the Pakistan population is lacking but according to detailed studies of the lynx in Russia and North America (Bobrinskii et al., 1965, and Burt and Grossenheider, 1952) the period of gestation is about 60–63 days and a litter size of two or three is normal although a litter of four kittens has been recorded for the Siberian Lynx (Ognev, 1935). In the Himalayas it is almost certain that only one litter a year is produced and that the young are born in the spring or early summer. Half grown cubs have been observed in the Himalayas (Ladakh) in late August on two occasions by Col. Stockley (1928) and Major Lowndes (1931). Another litter of three 'woolly cubs' were observed by Col. Stockley (1928) playing near their mother in July. Mating probably takes place from February to March so that the young are born mostly in April and May. The kittens are blind at birth, open their eyes after nine or ten days, and are weaned at about two months of age, up to which time they never emerge from their den or lair. They probably remain with their mother until four or five months old.

In Russia the males are reported to fight savagely during the breeding season (Ognev, op. cit.) Lynxes have been recorded as emitting a peculiar hissing call when threatened and male specimens have been described as emitting a high pitched howl which ends in a soft moan (Van den Brink, 1967). Captive specimens have lived up to 20 years (Crandall, 1964) and the Himalayan subspecies 16 years (Dover, 1933).

#### Subgenus CARACAL Gray, 1843

Distinguished from the subgenus *Lynx* by the relatively longer

tail (approximately over one-third of head and body length) lacking any terminal black tip and the comparatively longer more pointed ears, the backs of which are uniformly coloured black.

#### FELIS CARACAL

*Felis caracal* Schreber, 1776; Caracal or Red Lynx (see Illustration 42).

**Description:** Though coming within the category of the medium sized cats, the Caracal is more slender in build and smaller than the Himalayan Lynx. Of a uniformly brick red or almost pinkish-fawn colour, with comparatively long powerful limbs and lithe graceful build, it is a striking and handsome cat. The body fur is comparatively short and dense and even in young kittens lacks any conspicuous pattern of spots. The belly and inside of the lower limbs is creamy-buff almost fulvous and the skull is more slender and narrow than that of *F. lynx*. The long upstanding ears are set fairly close together on the top of the skull and they bear conspicuous long apical tufts of black hair. The backs of the ears are entirely black with a frosting of white hairs. In some individuals in winter coat the apical ear tufts measure up to 40mm (1.6in.) and often droop over. The face bears conspicuous black markings in the form of two short vertical bars above each eye and a broad black smudge above the corner of the mouth and at the base of the vibrissae. The area around the lips and the chin is whitish. The rhinarium is dark brown and the iris is amber coloured with the pupils contracting into vertical slits as in *Felis lynx*. The creamy-white vibrissae appear comparatively short, the longest measuring up to 70mm (2 $\frac{7}{8}$ in.), and the posterior vibrissae are black basally. The tail reaches just below the hocks and the paws appear relatively large and rounded with fully retractile claws. There is generally a scattering of indistinct darker brown spots around the lower flanks and belly. There is never any trace of a ruff of longer hairs around the cheeks. When standing the Caracal tends to look higher in the hind quarters than the shoulders.

A specimen in the British Museum from the Punjab had the head and body length 73.7cm (29in.) with the tail 22.9cm (9in.) and the hind foot 19cm (7 $\frac{1}{2}$ in.) and the ear 8.7cm (3.4in.). Average shoulder height varies from 40–46cm (16–18in.). Specimens from Africa are said to weigh 16–18kg (35–40lb) (Dorst et al., 1970). There are no records for the weight of the Indo-Pakistan population.

**Distribution and Status:** In Pakistan the caracal is found only in the remotest sparsely inhabited regions at lower altitudes. It is intolerant of human disturbance and has not penetrated into any of the higher mountainous regions. It is most typically found in extensive desert regions or low hilly country characterized by scattered sparse vegetation and arid conditions.

It is associated with arid subtropical scrub forest in northern Baluchistan and tropical thorn forest in the eastern desert border regions.

Throughout its range the caracal is rare and seldom seen. Even earlier natural history writers refer to the rarity of the animal in the subcontinent (Murray, 1884B and Sterndale, 1884). It occurs in the Mekran and Kalat State, in southern Baluchistan. Mumtaz Ali Khan, Locust Control Officer (pers. comm. 1968) saw an adult sunning itself near Kharan, Kalat State in the late 1960s. It occurs sparsely in Waziristan and a female with kittens was observed near Tank (R. Orr, in lit.). It also occurs sparsely in the hill ranges of Attock, Kala



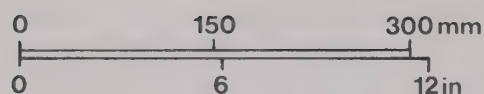


Illustration 42 *Felis caracal*: Caracal. (Based on live captive specimens in Bahawalpur Zoo from Yazman, Cholistan.)

Chitta Hilis and the Salt Range. A live male caracal was trapped in 1966 in the hills north of Jhelum and a female with two nearly fully grown young was observed near Traki in the Salt Range (Col. Sheikh-ur-Rahman, pers. comm.). Col. Stockley (1928) records seeing one in the Kala Chitta Hills. It is absent from the better settled riverine tracts of the Indus basin but occurs sparingly in Cholistan and Tharparkar. On two occasions live caracal have been trapped and brought to Bahawalpur Zoo from areas around Yazman in 1955 and 1956. It has been observed at Phulra beyond Fort Abbas near the Indian border. It has also been recorded in the plains north east of Loralai in the northern part of Baluchistan desert.

Extra-liminally the caracal occurs sparsely in the dryer parts of north east and central India around Kutch, Rajasthan, and Uttar Pradesh (Prater, 1965). It has been recorded in Iran, Afghanistan and Russian Turkestan up to the Kara Kum (Bobrinskii et al., 1965). It spreads through Arabia and the dryer areas of North Africa from Somaliland, Ethiopia and through the Sahara (Ellerman and Morrison-Scott, 1951). There is no evidence that its numbers have declined significantly in recent decades and it appears rarely to come into contact with human hunters.

**Biology:** Most writers in describing this species emphasize their speed and agility and the fact that they will remain above ground even in the hottest desert areas and do not seem to shelter in underground burrows (Stockley, 1928 and Prater, 1965). The caracal is believed to be capable of overcoming quite large game such as the chinkara (*Gazella gazella*) and H. B. Waite (pers. comm.) once observed a caracal stalking belly to ground a group of feeding Urial (*Ovis orientalis*) in the Salt Range. It also catches birds and has been described

as adept at stalking flocks of pigeons, Sand Grouse (*Pterocles* spp.) as well as peacocks (*Pavo cristatus*). Springing amongst the birds it is able to knock down one or two with lightning strokes of its paws before they can fly out of reach (Jerdon, 1874 and Ward, 1923). Peacocks (*Pavo cristatus*) still occur in the Thar Desert and must form an item of the diet of caracals



*Felis caracal* ○ Actual sightings  
▨ Probable range

Distribution Map 59 Caracal or Red Lynx.

inhabiting that region. Likewise Grey Partridge (*Francolinus pondicerianus*) frequent the same habitat in the Salt Range and Cholistan desert as the caracal. Ognev (1935) records how tame caracals in India could steal up to a flock of feeding pigeons and knock down several birds as they rose with a clatter of wings. Col. Ward (1923) gives an interesting account of a Punjab landowner who kept and trained caracals for hunting hares. D. L. Harrison (1968) refers to the caracal's ability to hunt snakes. Its long legs and lithe build certainly contribute to the incredible agility and speed attributed to this cat.

The breeding of caracals in captivity have been well recorded (Kralik, 1967 and Krishne Gowda, 1967). The gestation period varied from 69 to 70 days and mating was observed in one case on 26 April and on another occasion on 18 November. Females were sexually mature at 21 months and litter sizes vary from two up to six. New-born kittens are a light yellowish-fawn colour without spots, contrary to what Lydekker (1911, p. 340) has recorded. Their eyes open on the ninth and tenth day at which time they are a clear blue colour (I. Grimwood, pers. comm.). Captive-born kittens did not emerge from the nest box until three weeks of age and were not fully weaned until six months of age. This indicates that in the wild the caracal probably breeds only once a year. As with many Carnivora in sub-tropical regions the breeding does not seem to be particularly confined to any one season. Two kittens observed with their mother on 28 April near Tank were believed to be about  $2\frac{1}{2}$ –3 months old (R. Orr, in lit.). The young caracals, which were almost adult size, encountered in mid afternoon near Traki were observed in late October or early November (Col. Sheikh-ur-Rahman, pers. comm.). According to the member of the gypsy tribe (Jogis) who captured caracal cats for Bahawalpur Zoo, the young

were excavated from a burrow in the side of the sand-hill and they were born in August. This may have been the lair formerly excavated by some other animal such as a porcupine and it would appear that the caracal will shelter in underground burrows at least in the hotter desert regions of Pakistan. This Jogi animal trapper asserted that adult caracals were easy to trap with a bait of raw meat and that two or three kittens was the normal litter size in Cholistan.

There are many records of caracal kittens, when captured young, becoming very tame and making good pets and certainly it was the practice in parts of India to train them for hunting a hundred years ago. Captive specimens, however often appear very savage and those at Bahawalpur Zoo snarled and spat if approached too closely. A captive pair of caracal in Dublin Zoo lived to 16 and 17 years of age respectively (Shortridge, 1934), though six to seven years would seem to be the more usual life span in captivity (Dover, 1933).

#### Subgenus PRIONAILURUS Severtzov, 1858

Cats of this subgenus are distinguished by having a spotted pelage and being of small to moderate size with the skull markedly elongated and the palate more elongated than in the Genus *Felis*.

#### FELIS BENGALENSIS

*Felis bengalensis* Kerr, 1792; Leopard Cat (see Illustration 43).

Subspecies *Felis bengalensis trevelyani* Pocock, 1939.

**Description:** This is a relatively small cat with a beautifully marked pelage, as its name implies. Compared with local

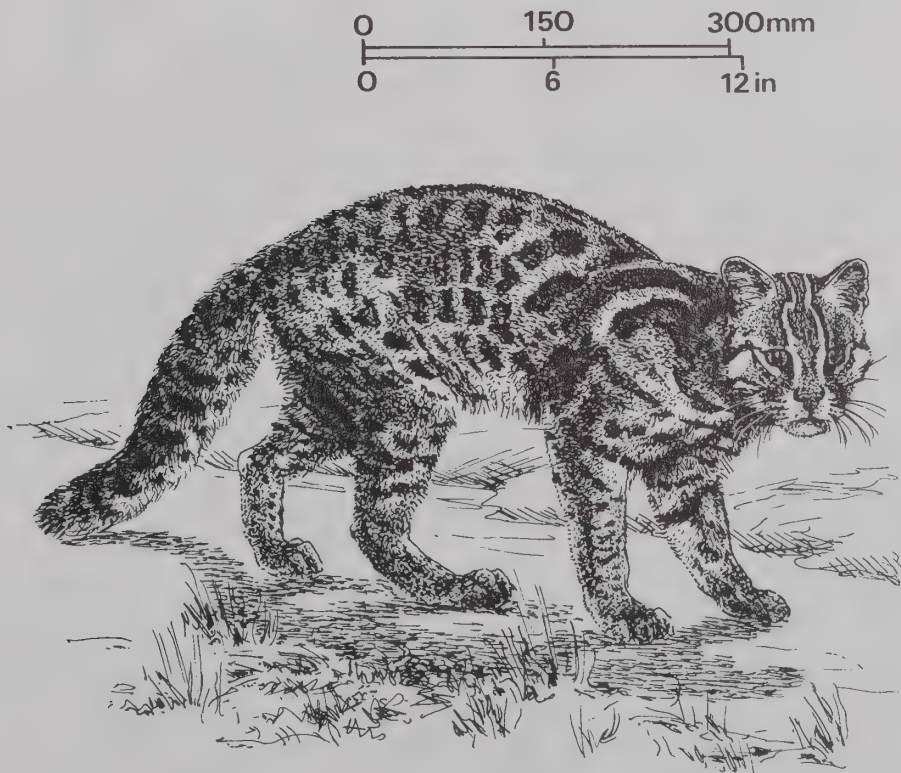


Illustration 43 *Felis bengalensis*: Leopard Cat. (Based on fresh killed specimen adult female from Dunga Gali, Murree Hills.)



breeds of domestic cats in Pakistan, the Leopard Cat appears to have longer legs and a slightly shorter tail and its ears are more rounded and shorter. Specimens from the northern regions have a rather thick tail with woolly under-fur. The ground colour varies from some shade of tawny to pale yellowish-buff and the whole body is handsomely marked with solid black spots. These are smaller on the lower part of the legs and coalesce into one or two broad longitudinal streaks in the region of the scapulars. The tail bears irregular black spots except for its extreme distal portion which bears one or two indistinct rings and a black tip. The forehead also is patterned with four or five vertical narrow black stripes in contrast to the spots on the forehead of *Felis libyca*. The belly fur is creamy-white and long and silky in winter coat with a few scattered black spots. The backs of the ears are black with conspicuous circular white spots which pattern occurs in the Fishing Cat (*Felis viverrina*), Tiger (*Panthera tigris*) and Marbled Cat (*Felis marmorata*). The naked rhinarium is reddish-brown. The iris is pale golden-green and there are well developed white vibrissae. There is also a conspicuous area of black hairs surrounding the inner corners of the eye and a broad irregular black streak extending from the outer corner of the eye to the base of the ear.

The population inhabiting Pakistan is referable to the Subspecies *Felis bengalensis trevelyani* which is distinguished by its comparatively larger size, and paler greyer ground colour to the pelage with longer fur. Specimens from the extreme north (Gilgit) are much bigger than domestic cats and more grey in colour. Specimens from the Murree Hills are slightly smaller and more creamy-yellow in body colour. A female from Dunga Gali had the head and body length 53.5cm (21in.) with the tail 27cm (10.6in.), the hind foot 11.5cm (4½in.) and the ear 4.5cm (1¾in.). There are no fresh measurements available for specimens from Gilgit but judging from trade skins they are considerably bigger than the measurements given for this Dunga Gali specimen. The weight varies from 2.4 to 5kg (5.2–11lb).

**Distribution and Status:** The Leopard Cat is a forest species normally associated with Himalayan moist temperate forest in Pakistan but it has penetrated into Himalayan dry coniferous in regions further north.

Because of its richly spotted fur this cat has been highly prized by furriers and much persecuted so that it has become extremely rare throughout most of its former haunts in Pakistan. It still occurs in the Murree Hills and the forests of the Neelum Valley in Azad Kashmir as well as the Kaghan Valley around Shoghran. It also occurs in Swat Kohistan and northern Dir and it is also known in the forests of lower Chitral though local hunters allege that it is very rare. A very sparse and scattered population appears to have been able to spread northwards into Gilgit. A specimen has been collected from the forest regions of Chilas District and another one from Ishkoman which is relatively arid and a treeless region.

The southern distribution of this cat in Pakistan presents some fascinating puzzles. It appears to have extended its range sparsely through the Safed Koh Mountains and higher forested ranges of Waziristan, though Peshawar furriers say that they seldom get skins from these regions. There is in the British Museum a skin of this species collected in extreme south east Baluchistan in Las Belas in the 1920s. I have also seen incomplete trade skins from the arid hills of Dadu and Larkana District which are heavily spotted and resemble *F. bengalensis*. The present very limited evidence however



*Felis bengalensis* □ Known distribution  
▨ Probable range  
*Felis viverrina* ▩ Known distribution

Distribution Map 60 ◻ Leopard Cat.  
▩ Fishing Cat.

suggests that it is unlikely that this forest dwelling cat succeeded in penetrating so far south into regions which appear to have been treeless for many hundreds of years. Since *F. bengalensis* and *F. libyca* have been known to hybridize with domestic cats, these heavily spotted specimens from Sind Kohistan and Las Belas may represent an unusually marked population of *F. libyca* though the single skin in the British Museum labelled from Las Belas appears to be *Felis bengalensis*.

Extra-limitally the Leopard Cat extends throughout the warmer tropical forests of south east Asia including Indonesia, the Philippines, Malaysia, Borneo, Taiwan, China and Korea. In India it is confined to the forested regions of the Himalayas, south India and Assam (Prater, 1965). In Russia a very big subspecies with rather paler brownish spotting on its pelage occurs in the deciduous oak forest region of south east Siberia in the Amur and Ussuri Basin (Bobrinskii et al., 1965). Many recent Russian authorities still refer to this subspecies as *Felis euphilura* (Sokolov et al., 1963, and Flint et al., 1965).

Since the skin of the Leopard Cat fetches a high price, they are killed whenever encountered by local hunters. In 1967 a Peshawar fur trader (pers. comm.) stated that he seldom received any skins of this cat from the surrounding hills of Khyber and Kurram agencies whereas he formerly used to obtain many specimens from these regions. However such traders still maintain big stocks of skins of this species, which they allege come from Swat and Dir and it is in danger of becoming almost extinct in Pakistan region if there is no restriction on the trade in its pelt. It must, however, be recognized that the Leopard Cat has a wide distribution in other parts of the world and is still relatively common in regions such as Assam and Malaysia (Gee, 1964 and J. Harrison, 1966).

**Biology:** The Leopard Cat is seldom encountered because it is strictly nocturnal in habits and lives in areas of relatively thick vegetative cover. They climb trees frequently

and are believed to be more arboreal than any other wild cat species found in Pakistan. By day they may shelter in some hole in a tree or occasionally in a crevice under the roots of a tree or between rocks. They appear to feed principally on small birds, but probably also hunt Wood Mice (*Apodemus sylvaticus*) and Flying Squirrels (*Hylopetes* spp.) which frequent the same habitat. In parts of India as well as Malaysia they are notorious for attacking and killing domestic chickens (Jerdon, 1874 and J. Harrison, 1966).

In India breeding apparently normally takes place in the spring and summer months (Prater, 1965) with two to three kittens being the normal litter size. In south India a litter of four was discovered in May (Sterndale, 1884). They have also been recorded as interbreeding with domestic cats (Sterndale, op. cit.). They have been successfully bred in captivity (Dathe, 1968). Nothing is known about the breeding of this species in Pakistan but it is presumed that they breed only once a year owing to the severeness of the winter in regions where this species occurs. Five litters from one captive breeding pair were produced in successive years, in March, April, June and August and in each case comprised three kittens (Dathe, 1968). In spite of leaving the kittens with the mother for 12 months a second litter was produced. In one instance the pair bred twice in the year, in March and early August, but it is noteworthy that the March litter was not successfully reared.

Many authors indicate that the Leopard Cat is particularly savage and untameable in captivity (see, for example, Jerdon, 1874; Finn, 1929; and Prater, 1965). However there is an

account of a female obtained as a kitten in north Bengal (India) which became completely tame and even affectionate (Gee, 1962). This cat appeared to like water and it swam readily. By day she preferred to sleep in the branches of a tree ignoring the box provided for her. It is noteworthy that captive specimens in East Berlin Zoo preferred sleeping at the extremities of branches rather than the nesting box provided and they appeared able to relax and sleep in fantastic postures (Dathe, 1968).

An adult female shot at Dunga Gali was encountered sitting motionless on a forest path just at dusk. Its stomach was empty but contained several unidentified parasitic roundworms about 35mm (1.4in.) in length. Specimens in captivity have lived up to 13 years.

### FELIS VIVERRINA

*Felis viverrina* Bennett, 1833; Fishing Cat (see Illustration 44).

**Description:** The Fishing Cat is broadly classed among the smaller cats and the small rounded ears with black dorsal surfaces bearing conspicuous white patches show its close affinity with *Felis bengalensis* as also the relatively long narrow skull. Here, the resemblance ends, however, because the Fishing Cat lacks the long legs and graceful lines of *Felis bengalensis* and an adult male appears quite massive and powerful with a deep body and relatively short thick tail. An adult male can weigh as much as 11.3kg (25lb) and a specimen

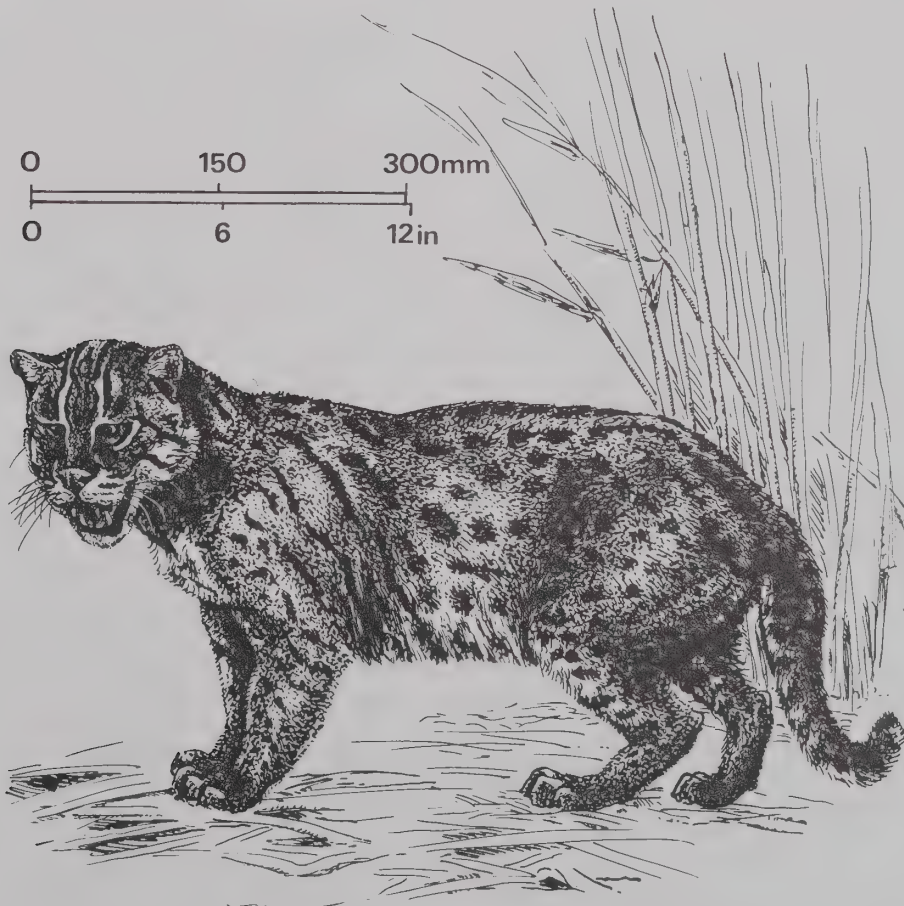


Illustration 44 *Felis viverrina*: Fishing Cat. (Based on live captive specimen in possession of J. A. W. Anderson, adult male three year old from Haleji, Sind.)



from Sind had the head and body length 720mm (28.4in.) with the tail 288mm (11.3in.) and hind feet 158mm (6¼in.) and the ear 57mm (2¼in.). The ears appear comparatively small and there are four or five narrow vertical stripes running down the crown to above the eyes with other black stripes radiating from the corners of the eyes. The area around the muzzle and lower cheeks is white as well as a conspicuous rim around the upper margin of each eye. The naked gums are black and the tongue a typical bright pink colour. There is a conspicuous patch of smooth black hairs below the inner corner of the eye similar to that in *Felis bengalensis*. The body fur is an earthy-grey colour with a more olivaceous tinge along the spinal area and it is covered all over with small elongated black spots running in horizontal lines. In places these spots merge into short streaks. The fur is comparatively coarse and harsh though the belly fur is soft and longer and of a creamish-grey colour with scattered black spots. The tail appears very thick and muscular in its proximal part, no doubt an adaptation to its use as a steering device when the animal is swimming. There are five or six black rings around the tail which terminates in a black tip. The outer extremities of the limbs have a scattering of small spots and there is a partially developed web of skin between each of the digits, much more conspicuous than those of domestic cats for example. The claws are not fully retractable into their sheaths.

With its heavy body and longish face the Fishing Cat looks distinctly malevolent. Females appear to be markedly smaller according to my observations of two different pairs captured in Sind.

**Distribution and Status:** In Pakistan the Fishing Cat is confined to riverain or swamp areas wherever there is permanent water in conjunction with extensive reed beds and tall grasses such as *Saccharum spontaneum*. It also inhabits coastal areas where mangrove and tamarisk bushes intermingle and is never found far from water.

It is now very rare in Pakistan, which country forms the extreme western limit of its world distribution. It is mainly confined to the Indus riverain tract in its southern portions, with an occasional straggler in the extreme north east wandering down the Ravi or Sutlej Rivers. Animal exporters within the past four or five years captured specimens from Haleji and Kalri Lakes around Thatta as well as in some of the 'dhands' on the east bank of the Indus around Sujawal. It appears still to survive precariously in the swamps around Jamroa Head in the east Nara (Karim Dad Junejo, pers. comm., 1973). A few still survive in the Indus riverine forests south of Sukkur (Mir of Khairpur, H. H. Mirali Murad Talpur, pers. comm., 1973). (See Distribution Map 60.)

In the north eastern region of the Punjab a large male was killed 12 miles north of Lahore near Batapur by Mr. Krebb in 1968. Another male was shot by Major S. A. Khan near the Sutlej River beyond Kasur in 1966. R. D. Taber (1967) describing the mammals of Lyallpur region refers to a large cat killed in the reeds alongside the Chenab River in the early 1960s, believed to have been this species.

Extra-liminally the Fishing Cat is a uniquely endemic oriental faunal zone species, apparently with a rather restricted and discontinuous distribution. It occurs in the Himalayan foothill region of the Terai in India extending eastwards to Nepal and Assam. It also occurs in coastal swamps of Kerala (South India) and Ceylon. It has not been recorded from Malaysia or with certainty from Burma but specimens have been collected from Thailand and Indonesia (Ellerman and Morrison-Scott, 1951).

Southern Sind was the only stronghold of this cat in Paki-

stan and it is now fast disappearing because of increased cultivation adjacent to the Indus river and the shrinking of inundation areas from that river. Increased human exploitation of the remaining swamp areas, both by fishing and cattle grazing, with its attendant reed burning, has driven the Fishing Cat out of most of its former haunts.

Its skin is esteemed by the fur trade and this rare and interesting cat must be protected if it is to remain on the list of Pakistan's fauna.

**Biology:** Inhabiting regions of dense cover, *F. viverrina* is rarely seen, particularly as it appears to be largely nocturnal in habits.

Because of its size it is a powerful and formidable hunter, and can adapt itself to catch prey in almost any kind of terrain. Many earlier writers have cited instances of the Fishing Cat successfully attacking and eating dogs, young calves and even unattended infants (Jerdon, 1874 and Sterndale, 1884). Pocock (1939) states that its teeth are not especially modified for catching fish and that it probably feeds upon any terrestrial vertebrate animal which it can overcome. Eates (1968) also cites instances of this cat having seized babies slung in hammocks from tree branches while their mothers went to cut grass nearby. Prater (1965) states that it does not enter water in pursuit of its prey and this has been asserted by other authors (Carrington, 1949). According to my own observations, and information from local animal trappers, the Fishing Cat is very much at home in water, being able to swim powerfully with its body completely submerged as well as on the surface. A specimen pursued by dogs was observed to swim a considerable distance down a narrow channel without exposing any part of its body. It appeared to have its eyes open the whole time and propelled itself by powerful strokes of its hind feet. In Sind its main food appears to consist of waterfowl, which it catches by swimming up to them whilst fully submerged and seizing them from underneath. Coots (*Fulica atra*) and ducks are secured in this way.

Undoubtedly the Fishing Cat deserves its reputation for strength and boldness. Several authors record that it will attack and kill feral dogs (Pocock, 1939 and Prater, 1965). An animal trapper named Hasham recounted to me the pursuit of a large male Fishing Cat encountered near Thatta by three dogs. It appears that the cat after trying to shake off its pursuers turned round and struck one of the dogs such a blow with its paw that it ran away howling and was later found to have broken its jaw. The second dog was grasped around the neck and thrown to the ground whilst the third dog was actually seized and carried away by the cat. Sterndale (1884) records that a captive Fishing Cat in his possession attacked and killed a leopard cub twice its size and J. A. W. Anderson had a young captive which attacked and killed a Tawny Eagle (*Aquila rapax*). The eagle was secured by jesses but was still a formidable prey for any carnivore to overcome.

Fishing Cats have been bred in captivity in both Frankfurt and Philadelphia Zoo. Observations at Philadelphia indicated that two appeared to be the usual litter size which agrees with the observations of animal trappers in Sind. The kittens born in Philadelphia were blind and unable to crawl at birth, becoming physically mobile at 12 days old. They still continued to suckle until about six months of age and did not eat their first solid meal until 53 days old (Ulmer, 1968). These captive kittens made an almost bird-like chirrup when calling their parents. They became very playful as they grew older. It was also noted that when newly born the ears of these kittens were closed, the pinna being folded forwards over the orifice.

In southern Sind young kittens have been captured in January and February but they may well be capable of breeding throughout the year. One Fishing Cat's lair, discovered near Sujjawal, consisted of a rough nest of reeds in a dense thicket of Phragmites. The remains of a Coot (*Fulica atra*) and a Wood Sandpiper (*Tringa glareola*) were found in this nest (J. A. W. Anderson, pers. comm.).

Zoo captives have been described as excessively wary, so that their normal behaviour is difficult to observe (Ulmer, 1968). Mr. Blyth in Jerdon (1874) stated that he had kept several specimens which became quite tame and J. A. W. Anderson kept a male for over three years from the time it was a small kitten, secured near Haleji. This specimen was affectionate and could be handled freely by its owner. It climbed trees well and enjoyed swimming when taken near water. At this time I observed it swimming with its head well clear of the water and using both fore and hind legs with the tail acting as a rudder. It was never heard to 'purr' but occasionally at night-time it would call in a rapidly repeated 'eh-eh-eh' (J. A. W. Anderson, pers. comm.). F. A. Ulmer (1968) described a similar call emitted by the male at Philadelphia Zoo during the mating season. Captive specimens have lived 10 years (Dover, 1933).

#### Genus *PANTHERA* Oken, 1816

Very large and powerful cats with the larynx modified to allow great distension at the back of the mouth for resonance.

#### Key to the Subgenus *PANTHERA*

Dorsal profile of skull flattish with no concavity where the muzzle passes into the frontal interorbital region. (See Fig. 44.)

#### Key to the Pakistan Species of *PANTHERA*

- (a) Pattern of body fur consisting of black spots arranged in rosettes against a tawny-buff background. No prominent black stripe from inner corner of the eye to the mouth. Tail relatively slim.  
... *Panthera pardus*
- (b) Very large size. Body with orange-tawny ground colour and thin vertical black stripes.  
... *Panthera tigris*

#### *PANTHERA PARDUS*

*Panthera pardus* Linnaeus, 1758; Panther or Leopard (see Illustration 45).

Subspecies *Panthera pardus fusca* Meyer, 1794  
*Panthera pardus saxicolor* Pocock, 1927  
*Panthera pardus sindica* Pocock, 1930  
*Panthera pardus millardi* Pocock, 1930

**Taxonomy:** M. S. Siddiqi (1961) lists all the above four subspecies in his checklist of mammals relating to Pakistan territory. The present day population is so thinly distributed that it is hardly possible to separate individual specimens into so many recognizable subspecies though the population from southern Baluchistan and Sind Kohistan averages smaller in size than those from the northern Himalayan regions. Throughout its range, there is considerable individual variation in the pattern and density of the spots or rosettes on the body.

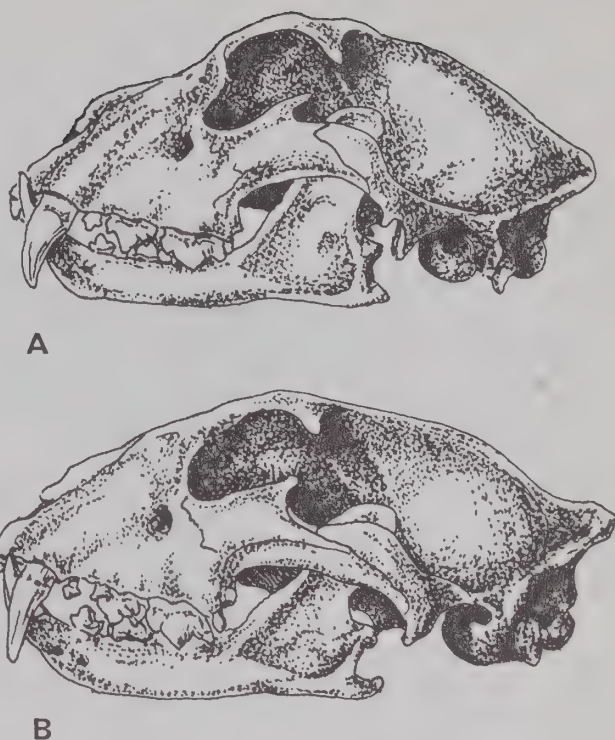


Fig. 44 Lateral view of skulls showing difference between Snow Leopard and Panther.

- A. *Panthera uncia*. Note less prominent sagittal crest and dish-shaped or concave profile in front of orbits.
- B. *Panthera pardus*. Note relatively smooth convex profile of skull in region of temple.

**Description:** The Panther, belonging to the group of large cats, is too familiar an animal to warrant detailed description. A large male may stand up to 66cm (26in.) at the shoulder and measure 117cm (46in.) head and body length. The tail which is long and slender averages about two-thirds of the head and body length, but can vary considerably in individual length. Dunbar Brander (1931) records a variation from 71–96.5cm (28–38in.) in tail length of Indian specimens. Panthers from the more arid regions of Baluchistan weigh not more than 40kg (90lb) and measure 91.5cm (36in.) from nose-tip to root of tail. Large specimens from India have been killed weighing as much as 69kg (152lb). Females are invariably smaller weighing about 6.8kg (15lb) lighter than males.

The panther has a deep, laterally compressed body with comparatively short stout legs and very broad massive forepaws (see Fig. 45). The neck is thick and muscular and the muzzle rather long and broad. The short rounded ears are black on their dorsal surface with conspicuous round white spots. The body colour varies from a golden orange colour to a paler greyish-fawn closely marked all over with black rosettes comprised of four or five concentric spots. Specimens from the Himalayan mountain regions of Pakistan have a long thick pelage in winter, the belly fur being particularly long. Specimens from southern Baluchistan, Waziristan and Sind Kohistan have short harsh fur. Captive specimens from Chitral and Swat, seen by me varied from paler greyish-fawn to tawny-buff in ground colour. The tail bears spots throughout its length and the forehead is also patterned with small spots. There are two authentic records of Black Panthers having been killed in Sind, one near Jacobabad in 1928 and the other just north of Karachi in 1939 (Eates, 1943 and



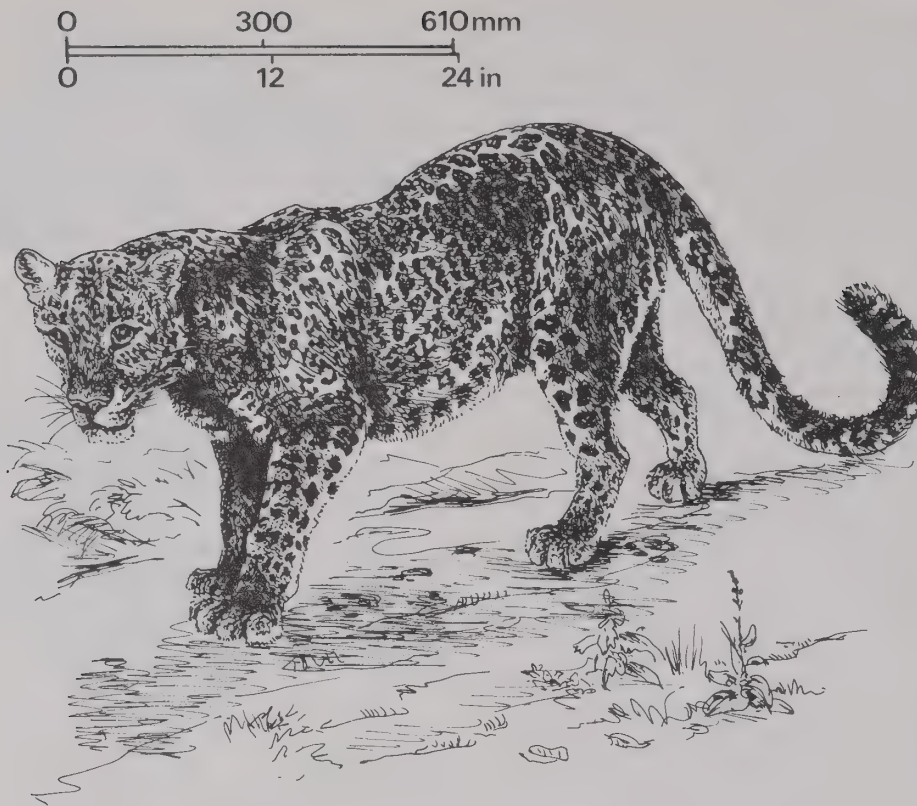


Illustration 45 *Panthera pardus*: Leopard or Panther. (Based on live captive specimen Lahore Zoo, adult male from Swat.)

1968). Unlike the smaller cats the pupils of the leopard contract to a small circle rather than an ellipse.

**Distribution and Status:** In Pakistan the panther is confined to Himalayan forest regions up to the limit of the tree-line or the lower altitude valleys in the more arid mountainous regions further north. It also inhabits broken hilly or mountainous country throughout Waziristan, Baluchistan and Sind Kohistan in association with acacia scrub forest. It formerly inhabited the Salt Range and still survives in the Kala Chitta Hills but has been absent from the more settled cultivated riverain tracts for many decades. In the southern part of its range, a few specimens are still occasionally reported from the Pab Hills whence a specimen was shot in 1968 by Dr. Rizvi. They still occur in the Kirthar Hills and Karchat Hills and very sparsely in the hill ranges of Kalat and Mekran. Dr. Schaller in 1973 saw signs (scats and tracks) in the Toba-Kakar range, as well as the Gishk Hills in Kalat. In the late 1960s two leopards were reported to be creating havoc amongst domestic goat flocks around Kaliphat in north east Baluchistan though there have been no recent reports of leopards from that region. Individual specimens frequently wander into the Murree Hills and almost every year there is a report of one being shot during the summer tourist season. They occur sparsely in southern Chitral around Rondu, and Chilas District of Gilgit, and they are probably slightly more plentiful in the better forested regions of Swat Kohistan and Hazara. There have been recent reports of panther still occurring in the Safed Koh Mountains as well as Takht-i-Suleiman and the North West Frontier Province.

Panthers presumably still occur very sparsely in Rajasthan (India) and individuals occasionally cross the border into

Pakistan. One such was shot in 1959 near Hasilpur (Bahawalpur Division) (Ahmad Nawaz Gardezi, pers. comm.). The late Nawab of Kala Bagh (pers. comm.) reckoned that about 12 panthers had been shot in the Salt Range in Mianwali District in a period of about 25 years up to 1967. Eates (1968) records that between 1896 and 1915, 21 panthers were officially reported as having been killed in Sind and that most of



*Panthera pardus*  
Distribution Map 61 Panther or Leopard.

these were from the hills immediately to the west of Karachi.

Increased human settlement as well as the possession of firearms has made the leopard extremely rare throughout Pakistan including the remoter mountain regions. It is eagerly sought after both as a trophy by sportsmen as well as by local hunters because of its valuable fur. Despite its adaptability to all types of habitat it continues to decline in Pakistan and it would not seem too pessimistic to anticipate that it will follow in the steps of the lion (*Panthera leo*) and the tiger (*Panthera tigris*) by becoming extinct within this century in Pakistan if present hunting pressure continues.

Extra-limitally the panther occurs throughout Africa to Cape Province and spreads through Asia from the Caucasus through Arabia, Iraq and Afghanistan and across to eastern Siberia. It occurs throughout India, Ceylon, Malaysia, Burma, Thailand, Indonesia and spreading into south west China.

**Biology:** Within Pakistan where human disturbance is high, panthers may travel over a very extensive hunting territory, and depending upon food supply, may not remain more than two or three days in one locality. In northern India it has been estimated that an adult panther travels over a circuit from 30 to 40 miles long during the course of a year's hunting (Champion, 1933).

Normally solitary, the panther gives evidence of being an extremely wary and intelligent animal, hunting mainly only at night and even entering the precincts of villages without being detected by their human occupants.

Panthers will kill a variety of prey and do not spurn even snakes, lizards and small rodents. In Pakistan their preferred food varies according to the locality. In Baluchistan they prey on female and sub-adult Sind Ibex and Markhor. In the Kala Chitta Hills they prey on Urial, and in the forest regions of the Himalayas the Rhesus Monkey as well as domestic dogs are the main prey species. In regions where natural game is limited, panthers are notorious for attacking domestic livestock and in Pakistan they have been known to kill adult cows as well as calves, donkeys, ponies, goats and sheep. In 1968 there was an instance of a pair of panthers attacking a camel near Kaliphat in north east Baluchistan. Swift fleeing animals may be knocked off balance by a blow with the forepaws, but are always finally overcome or killed by the panther gripping them in the region of the throat. The victim is subsequently pulled to the ground where it dies of suffocation, or even occasionally from a broken neck, since the panther does not release its hold until the victim is dead. In Dunga Gali a panther twice entered the bazaar at night-time during the summer of 1965. On one occasion whilst shops were brightly lit, a large white dog was carried off in front of two witnesses. According to local account the panther is believed to be particularly fond of preying upon porcupines both in the Kirthar Range and the Salt Range. These observations by local hunters are corroborated by many accounts in old journals of the Bombay Natural History Society describing panthers which were found to have porcupine quills embedded in their paws or head after they had been shot.

In forested areas Panthers frequently carry their kill up into a tree in order to be able to consume it without competition from other scavengers. Dunbar Brander recalls seeing a deer in central India hauled up into a tree. It is doubtful whether this habit is frequent in Pakistan. Out of two natural panther kills seen by me, one was a calf which had been partially eaten in the groin and it is believed that most panthers prefer to start eating at this point. The second, a

donkey was not eaten since the panther was disturbed immediately after making the kill. Its claw marks were clearly visible on the donkey's hind quarters as well as deep tooth punctures on the throat. Even in Pakistan it is probable that wild game comprises the greater part of their food, though the occasional panther attack on a domestic animal is so widely reported in the villages that they acquire an undeservedly bad reputation.

In India in the warmer tropical regions panthers appear to be able to breed throughout the year (Prater, 1965) though Dunbar Brander (1931) believed that more cubs were born just at the beginning of the monsoon than at any other time. The period of gestation varies from 98 to 105 days according to many records of successful captive breeding (Crandall, 1964). In the wild a litter usually comprises two and rarely up to four young and it is significant that the male appears to remain in attendance whilst the female is suckling. It seems probable that in the northern Himalayan regions of Pakistan litters are only produced in the spring and summer months.

During the day panthers lie up in natural caves or enlarged porcupine burrows. At night they tend to follow man-made paths or goat tracks and this habit has often been taken advantage of by local hunters in setting pitfall traps. It has been observed that if the grass is tall and wet with dew the panthers deliberately avoid walking through such grass preferring to use paths (Champion, 1933). They can swim but do not seem as fond of water as tigers (Stockley, 1928 and Dunbar Brander, 1931).

The call of a panther is not particularly loud or resonant, consisting of three to four quickly repeated coughing barks which have been likened almost to the rasping sound of a saw.

Panthers have been known to become dangerous man-eaters in India and there is a record of an individual which killed more than 200 persons within a period of three years (Finn, 1929). I have come across no known records of panther attacking man in Pakistan.

The panther has always been regarded with a mixture of fear and even contempt in Pakistan and it has been ruthlessly persecuted whenever encountered. Though its predation on half wild village dogs as well as crop destroying Rhesus Monkeys (*Macaca mulatta*) and porcupines, could be considered of benefit to man it will probably continue to be classed as vermin with no legal protection against hunting in this region because of its depredations upon domestic flocks. Captive panther have lived for 17, 18 and 21 years (Crandall, 1964).

#### Subgenus TIGRIS Oken, 1816

#### PANTHERA TIGRIS

*Panthera tigris* Linnaeus, 1758; Tiger.

The tiger is of course extinct in Pakistan but it should be a sobering thought that it has only become so within the last 70 years, in a region which cradled man's civilization for over 4000 years. J. A. Murray, in describing the fauna of Sind in 1884, stated that Khairpur State in the Indus riverine forest tracts was its last stronghold. The last survivor, a tigress was shot in 1886 by Col. McRae (Eates, 1968). The late Amir of Bahawalpur, H. H. Sir Sadiq Muhammad Khan Abbasi, related how his father had shot 13 tigers within Bahawalpur State territory in the Indus riverine jungles and that the last specimen was shot by him in 1906 a few miles below Panjnad (pers. comm., 1965). At that time the Indus River was sur-



rounded by a continuous belt from four to twelve miles wide of *Tamarix doica* and *Saccharum munja* jungle.

#### Subgenus LEO Oken, 1816

#### PANTHERA LEO

*Panthera leo* Linnaeus, 1758; Lion.

The last specimen of the lion recorded within Pakistan territory was an animal shot in Sind near Kot Diji in 1810 (Kinnear, 1920).

The Asiatic lion was supposed to have been hunted at the beginning of the nineteenth century in the thorn jungle around the bed of the old Hakra River near Derawar according to the late Amir of Bahawalpur (pers. comm., 1965).

#### Subgenus UNCIA Gray, 1854

Dorsal profile of skull with concavities where muzzle passes into frontal interorbital region. Orbits high and prominently elevated (see Fig. 44).

#### Key to the Pakistan Species of UNCIA

Fur very long and of a greyish-buff ground colour and black spots on flanks forming irregular hollow circles. Spots in spinal region of pelvis fusing into continuous lines. Tail noticeably thick and bushy and roughly equal to head and body length.

... *Panthera uncia*

#### PANTHERA UNCIA

*Panthera uncia* Schreber, 1776; Snow Leopard or Ounce (see Illustration 46).

**Description:** Of all the larger cats the Snow Leopard is perhaps the most beautiful. Its fur besides being thick and deeply luxuriant is most handsomely marked. Similar in general appearance to *P. pardus* it averages smaller in size with a relatively longer tail which is much thicker and bushier. The head and body length varies from 100–110cm (39–44in.) with the tail 84cm (33in.) in length according to flesh measurements from three specimens from Gilgit and Baltistan (Ward, 1924B). It stands about 56cm (22in.) at the shoulders. There appear to be no weight records but an adult female was estimated to weigh about 36kg (80lb) (Schaller, 1971C). Like the Panther, *P. pardus*, the fore-legs are relatively short and powerful and the paws appear particularly massive. The head differs markedly from that of *P. pardus* in that the skull in profile has a marked step in front of the eyes and this enables the skulls of the two species to be easily separated (see Fig. 44). It has a rather long broad nose with powerful jaws and relatively short rounded ears as in *P. pardus*. The back of the ears are rimmed with black the middle portion being whitish-yellow. The area around the lips is conspicuously black and the forehead bears a scattering of small solid black spots. The iris is pale green. The body colour is grey varying to greyish-buff with widely scattered black spots on the outer surfaces of the limbs merging to large black rosettes or irregular circles along the upper flanks and back. In the lower region of the spine these coalesce into two continuous black lines. The centre of the larger rosettes is generally of a darker grey than the rest of the body fur and in winter coat these spots give the impression of having been painted on to wet blotting paper. The dorsal surface of the tail bears two parallel rows of rosettes with darker centres. The distal one-

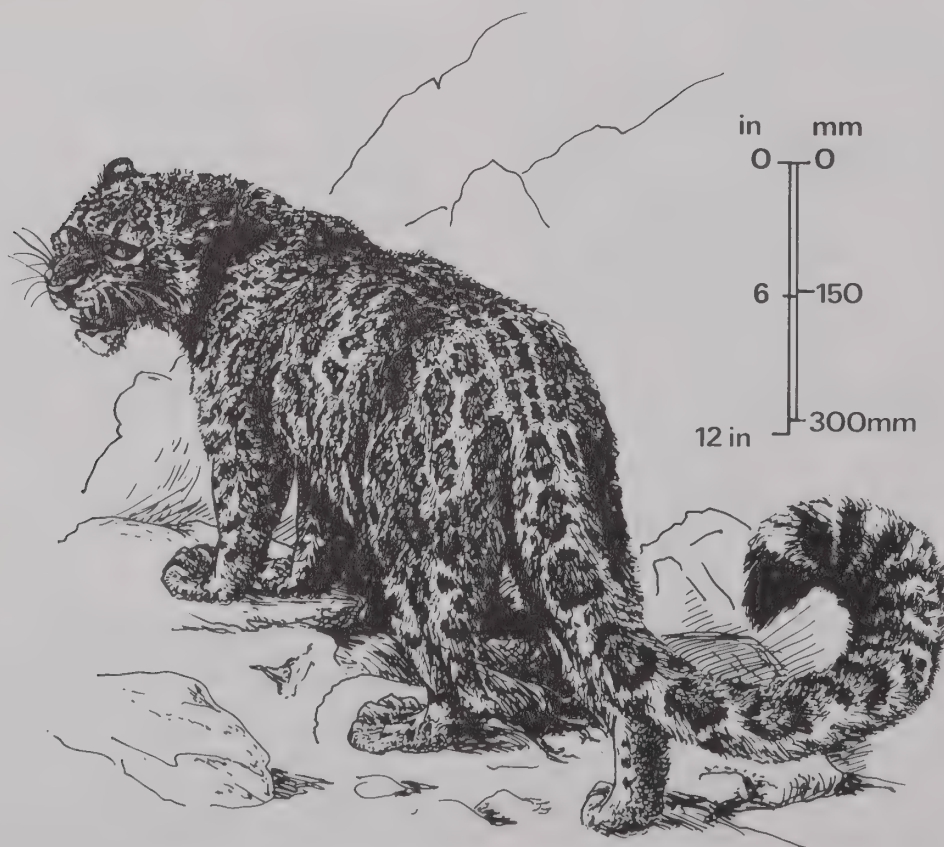


Illustration 46 *Panthera uncia*: Snow Leopard. (Based on trade skin of specimen secured near Chitral in November and photographs of six month old male from near Hunza.)

third comprise solid black blotches whilst the ventral surface of the tail is whitish-buff without spots. The fur in the region of the chest and belly is very long and luxuriant but also bears scattered black spots.

The very long thick tail is one of the most striking features of the Snow Leopard and it is undoubtedly an important balancing organ when the animal negotiates steep cliffs.

**Distribution and Status:** The Snow Leopard might more appropriately be called the Rock Leopard, inhabiting as it does comparatively arid alpine regions where its pelage merges imperceptibly with the grey rocks of its background. In Pakistan it inhabits the inner Himalayan ranges where both snowfall and rainfall is scant. In summer it ranges to the highest alpine meadows up to 5200m (17,000ft) elevation but in winter will occasionally descend the broad mountain valleys to as low as 1500m (5000ft). Several writers have stated that it remains above the limit of the tree line (Prater, 1965, and Walker et al., 1964). But in Pakistan this is definitely not so and in Chitral a female has been observed even in August as low as 1500m (5000ft) in *Quercus ilex* scrub forest whilst specimens have been seen on several occasions in the spruce (*Picea morinda*) around the lower slopes of Nanga Parbat to the south of Astor.



Distribution Map 62 Snow Leopard or Ounce.  
Cheetah.

Snow Leopards occur very sparsely in northern Chitral and over most districts of Gilgit, in northern Hunza and Baltistan. Many years ago a Snow Leopard was shot within a short distance of the Residency in Gilgit town at about 1500m (5000ft) elevation though it is probable that they spend most of the year in much higher and remoter mountain regions. There is no definite record of Snow Leopards occurring in Swat Kohistan but they have extended southwards into Indus Kohistan on the left bank of the Indus south of Gilgit where Major A. Gsell shot a specimen in 1962. They are probably least rare in the northern regions of Hunza and the

Deosai Plateau in Baltistan but this beautiful animal must be considered as very thinly distributed in Pakistan. Its luxurious pelt is still purchased by tourists from the shops of Rawalpindi and Peshawar and local hunters could obtain the equivalent of £15–£20 for an uncured skin in 1972 (*Animal Magazine*, 1972). Apart from this in many parts of Gilgit when a local man succeeds in killing one of these creatures he is rewarded and feasted by the entire village because they are considered so destructive to the goat flocks (Rajah of Gupis, Hasan Ali Khan, pers. comm.). Legislation was promulgated in 1968 in Pakistan banning the trade in leopard skins but this has not been effectively enforced up to the time of writing. Six Snow Leopards were known to have been killed in Chitral during the winters of 1971/72 (G. B. Schaller, pers. comm.) and it is still possible (1973) to see Snow Leopard skins hanging on display in furrier shops.

Extra-limitally the Snow Leopard extends eastwards across the Himalayas through Nepal and Bhutan and occurs sparsely throughout Tibet and Outer Mongolia. It also occurs in the northern mountain regions of Afghanistan and the USSR in Tien Shan and Altai Mountains (Bobrinskii et al., 1965). There is no valid evidence of its occurrence in Iran. The IUCN lists this species in the Red Data Book as being in danger of extinction and certainly it is becoming increasingly rare and in need of protection from fur traders. The estimate for the whole Himalayan complex of mountains was given as 400 (IUCN, 1970). In the opinion of experts like Dr. G. B. Schaller this estimate appears too low.

**Biology:** The Snow Leopard lives a solitary existence and like *P. pardus* appears to travel widely and to hunt over a very extensive area. Two individuals observed by Schaller (pers. comm., 1973) in Chitral only remained one week and four days respectively within particular valleys before moving elsewhere though they were tempted to stay with a plentiful supply of live goats as bait. Like other carnivores inhabiting high mountain areas, the Snow Leopard is not exclusively nocturnal. Col. Stockley (1928) observed one stalking Ibex (*Capra ibex*) by daylight. In the daytime they probably shelter in some natural cavern or cleft beneath an overhanging rock but they are fond of sunning themselves on some rocky ledge at times. I know of two recent instances where unsuspecting Snow Leopards were killed by hunters whilst sleeping in the middle of the afternoon (Manzoor-ul-Haq, Astor, pers. comm., Major A. Gsell, Indus Kohistan, pers. comm.).

The Snow Leopard probably preys mainly upon Markhor (*Capra falconeri*), Ibex (*Capra ibex*) and Bharal (*Pseudois nayaur*), and domestic stock, in Pakistan. Out of 16 Snow Leopard scats examined by G. Schaller (in lit., 1970) in Chitral Gol Reserve, five contained remains of Markhor, eight had remains of domestic sheep and goats, two consisted of unidentified forbes and one of soil. Lydekker (1907) describes them as preying mainly upon Bharal in Ladakh. No doubt they will prey upon smaller animals such as hares (*Lepus capensis*), Long-tailed Marmots (*Marmota caudata*) and even Himalayan Snow Cocks (*Tetraogallus himalayensis*). Unfortunately there are many recorded instances of Snow Leopards attacking domestic sheep and goats, and they appear occasionally to kill such domestic stock wantonly and in excess of their needs. A Snow Leopard in Yasin District of Gilgit broke into a hut in which goats were penned and killed or maimed eight animals before it was frightened away by the aroused villagers (Rajah of Gupis, Hasan Ali Khan, pers. comm.). Pocock (1939) refers to a pair of Snow Leopards which harassed the farm of the Moravian mission at



Kailing in Lahul, regularly marauding domestic livestock and it is noteworthy that in a village near this same mission, a Snow Leopard entered a house at night-time in mid winter. One end was occupied by the human owners, and the other by goats to which the leopard must have been attracted. The man seized a burning stick from the fire and succeeded in beating off the Snow Leopard (Friedel Peters, pers. comm., 1965).

Snow Leopards have proved to be rather delicate animals in captivity and they have only recently been successfully bred in zoos. Several Russian and United States' zoos have now had repeated successes and a total of 45 litters have been recorded born in captivity (*International Zoo Year Book*, 1970). The gestation period varied from 98–103 days with females generally coming into oestrus towards the end of winter (Yunchis, 1968 and Frueh, 1968). In Pakistan a litter of two cubs was captured in Hunza in 1965 which appeared to have been born in late May or early June. One of these cubs was successfully reared to six months of age before it was exported to Frankfurt Zoo. It was quite amenable to being handled by certain family members and played like a domestic kitten when younger (W. Mumby, pers. comm.). Two years previously he also received another litter of two cubs from Hunza which appeared to have been born in early June. In 1957 a litter of three cubs was found near Rama Lake, Astor District, Gilgit in late June. These cubs, presented to the tehsildar, did not survive more than a few days in captivity, and from his description appeared to have been very young. A female Snow Leopard with a cub was observed by several persons in November and December 1970 in Chitral Gol Reserve. G. Schaller (pers. comm. 1970) estimated that this cub had been born towards the end of August.

Like *P. pardus* the Snow Leopard has a habit of following definite tracks such as goat tracks and the local hill people sometimes succeed in capturing them by digging pit traps across such regularly frequented paths. As mentioned earlier they are very agile in climbing up precipitous rock faces and can leap tremendous distances (Ognev, 1935). The young cubs reared by W. Mumby emitted a sort of whimpering cry not unlike a calf bleating when they were hungry. Even when not under observation they tended to move with a rather crouching and slinky gait with their belly close to the ground. When feeding they made a spitting noise similar to domestic cats if approached too closely. Schaller (pers. comm., 1970) recalls watching the female Snow Leopard in Chitral Gol sitting on top of a large rock during a snowfall. The snow visibly accumulated on top of the Leopard's head and back without the animal making any attempt to shake this off its fur, a testament to its wonderful insulating qualities. The same female killed a goat tied up as bait in the presence of G. Schaller (pers. comm.). The goat having observed its adversary and turning to face it was knocked over with a rush and seized by the throat and pulled to the ground.

#### Genus ACINONYX Brookes, 1828

Very large cats with long slender legs and build modified for cursorial predation. Claws on all feet only partially retractile and the body is marked all over with solid black spots, not rosettes, against a tawny-buff ground colour.

#### Key to the Pakistan Species of ACINONYX

A conspicuous black stripe extending from the inner corner

of each eye and down below the mouth. Body covered all over with solid black spots.

... *Acinonyx jubatus*

#### ACINONYX JUBATUS

*Acinonyx jubatus* Schreber, 1776; Cheetah.

It is generally considered that the cheetah has become extinct within the Indo-Pakistan subcontinent where it once was widely scattered throughout the dryer regions of central India and the Deccan Plateau (Prater, 1965 and Seshadri, 1969). In fact the final senseless slaughter of this harmless creature in India is recorded in the *Journal of the Bombay Natural History Society*. The ruler of Korwai State (wrongly referred to as Korea in the journal) shot three cheetah in one night as they stood transfixed in the head-lights of his car (Van Ingen and Van Ingen, 1948). There have been no authentic sightings since that date in India.

However, it is still probable that the Asiatic Cheetah enters Pakistan territory in the extreme south west of Baluchistan even if it is not permanently resident in that region. Due to the region's extreme inaccessibility, both geographic and political, it has not been adequately surveyed by any zoologists in recent decades. In 1912 a specimen was collected at Schorab in the southern part of Kalat State, and this skin is still in the British Museum collection. In the extreme south west of Fars Province of Iranian Baluchistan, cheetahs have been recently discovered still surviving in small numbers. The Chicago Field Museum has a specimen from Bampur close to the border of Kharan District in Pakistan in Baluchistan. The Street Expedition obtained a specimen in 1963 from Damin in Kerman Province (Lay, 1967).

Both the inhabitants of the Mekran and of regions further north in Chagai and Kharan have separate words in their language to distinguish the cheetah and the panther and interrogation of local persons has on many occasions led to the response that both species still occur in south west Baluchistan. In the Mekrani language the leopard is 'abtar' and the cheetah 'gurk'. In the Brahui language the leopard is 'khaleja' and the cheetah is 'yeoz'. The nephew of the Khan of Kalat claimed to have shot a cheetah near Turbat in mid February 1968 but it was not possible to see this skin. In 1972 J. A. W. Anderson (pers. comm.) obtained a trade skin which was alleged to have come from the border regions of the Mekran, and this is lodged with the Royal Scottish Museum. There is still a widespread population of gazelles (*Gazella gazella*) in these regions bordering Iran which would provide the natural food prey of the cheetah and it seems very probable that the above two records would relate to animals killed within Pakistan.

J. A. Murray (1884) stated that cheetah were still widespread in the dry hilly country to the west of the Indus River when writing about the fauna of Sind at the turn of the century. In 1970 a Peshawar furrier received a cheetah skin which came from Afghanistan traders and there was another skin in Lahore in 1972. Both these specimens had extremely long soft belly fur and could have come from mountainous colder steppe regions of Afghanistan bordering the USSR. They were both sub-adult specimens with a fairly pronounced dorsal crest of longer hairs extending from the nape down to the shoulder.

Throughout its range the Asiatic Cheetah is extremely rare and it is hoped that the species will be totally protected in Pakistan if it is possible to create a reserve in south west Baluchistan in collaboration with the Iranian Fish and Game Department who have already declared a reserve for the cheetah in that border region.

## 9 PERISSODACTYLA

The Perissodactyla are the odd-toed ungulates, large in size with toes separate and sheathed in horny nails. This whole order has very few surviving species though there are many fossil families and genera which no longer exist. It comprises six genera and only 17 species amongst which are all the large herbivorous hooved animals having an uneven number of toes on the hind feet. In Pakistan today only one species survives to represent the whole order, and this itself is sadly on the verge of extinction in this particular region.

### FAMILY RHINOCEROTIDAE – RHINOCEROSSES

#### Key to the Family RHINOCEROTIDAE

Body semi-naked or only sparsely covered with hair. Three toes on all feet. Central toe larger than others. One or two horns of dermal origin (not connected with the skull) and growing from the upper part of the snout.

**Genus RHINOCEROS** Linnaeus, 1758

#### RHINOCEROS UNICORNIS

*Rhinoceros unicornis* Linnaeus, 1758; Great One-horned Rhinoceros, or Indian One-horned Rhinoceros.

This huge and almost prehistoric-looking animal now has chances of survival in several widely separated reserves (e.g. Manas, Kaziranga, Jaldapara and Chitawan) which have been created in northern Assam and southern Nepal in the Himalayan foothill zone, regions of extensive swamp and tall grass. It is difficult to believe that it once ranged right across the Himalayan foothills to Pakistan. The great Moghul Emperor Baber gives accounts of hunting this beast in the Vale of Peshawar in what is now the North West Frontier Province. They were armed only with a cross-bow and arrow for such hunts. This was around 1526 and presumably at that time suitable riverine grass thickets and swamps extended right across the foothill zone of the Himalayas. That the animal was well known to the Indus Valley peoples in ancient times is further corroborated by seals which have been excavated at Harappa (Sahiwal District on the Ravi River) clearly depicting *R. unicornis*.

### FAMILY EQUIDAE – HORSES AND ASSES

#### Key to the Family EQUIDAE

Horse-like mammals with reduction of toes to one broad hoof. Body well covered with hair and having crest of longer hairs on top of neck.

**Genus EQUUS** Linnaeus, 1758

#### Key to the Pakistan Species of EQUUS

Body uniformly coloured reddish-buff with dark brown spinal stripe.

... *Equus hemionus*

#### EQUUS HEMIONUS

*Equus hemionus* Pallas, 1775; Asiatic Wild Ass (see Illustration 47).

Subspecies *Equus hemionus kbur* Lesson, 1827; Indian Wild Ass or Ghor-Khar

**Taxonomy:** The Asiatic Wild Ass ranges from the high uplands of Central Asia and formerly through the desert areas of Afghanistan, Iran and Baluchistan to Sind and the Rann of Kutch. Five distinct subspecies have been recognized. The Kulan, being the nominate subspecies *E. hemionus hemionus*, extends from Mongolia at the extreme north east of its range to Kazakhstan in the west. The Kiang, *E. hemionus kiang*, is well known to travellers in Tibet and Ladakh (Stockley, 1936). The Syrian Wild Ass, *E. hemionus hemippus* is presumed to be extinct (Bannikov, 1971). The Persian subspecies, is *E. hemionus kbur* and this animal extends from Afghanistan down into Iran and the Rann of Kutch.

**Description:** Larger than the Wild Asses of Ethiopia and the Sudan (*Equus asinus*), the Onager is a handsome reddish-tan animal with creamy-white legs, belly and a dark brown hog mane. It differs also from domestic strains and the North African Wild Ass, in having comparatively shorter ears, no trace of horizontal dark stripes on the upper part of the legs, besides being markedly bigger, and lacking blue grey fur tones.

The upright stiff mane of hairs ends abruptly on the poll and consists of dark chestnut hairs up to 6.5 cm in length in the middle of the neck where they are longest. The head is comparatively large with a broad rounded muzzle which is creamy-white and the upper lip in skins examined from the Rann of Kutch, is well covered with stiff bristle-like fawn hairs. The ears have conspicuous dark brown tips on their inner margin and measure 19–20 cm in length. There is a broad dark chestnut brown stripe extending from the withers to the proximal third of the tail. This stripe is narrow over the shoulders, being 1 cm wide broadening noticeably over



Fig. 45 Showing lateral view of skull of adult male *Equus hemionus*. Note very small tush or canine tooth in upper jaw only.



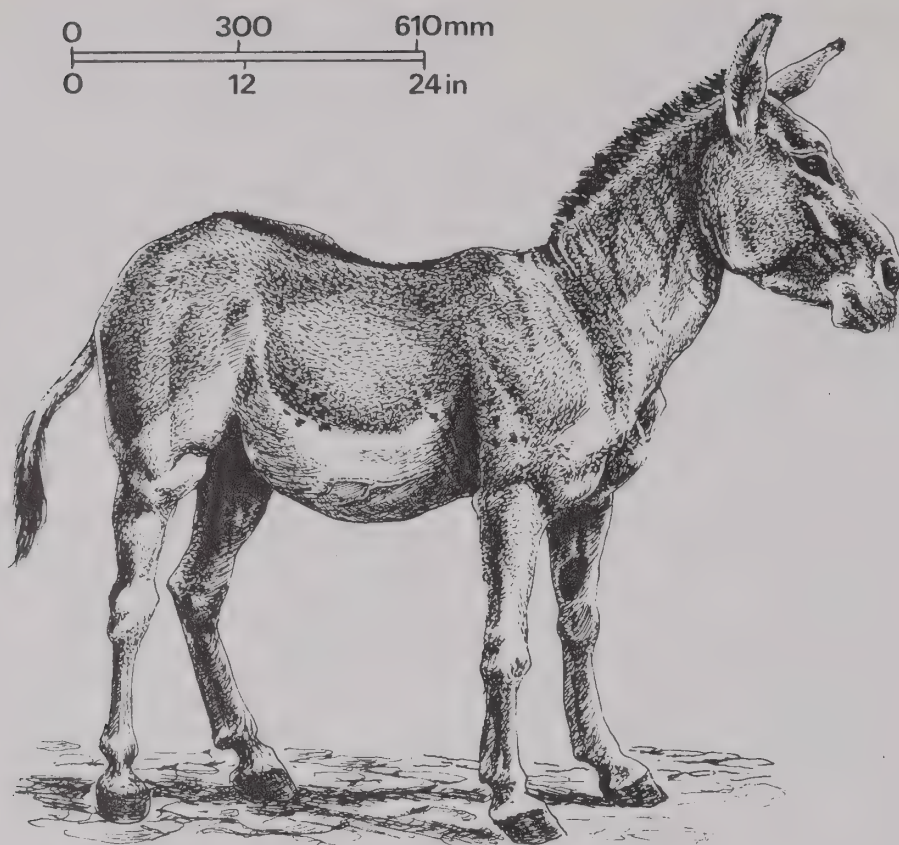


Illustration 47 *Equus hemionus*: Asiatic Wild Ass or Onager.  
(Based on study specimen in collection of Bombay Natural History Society, adult male from Little Rann of Kutch, India and live captive specimens of unknown origins in Regents Park Zoo.)

the rump until it is 8cm wide in front of the pelvis. The tail terminates in a coarse long tuft of black hairs and measures from 310 to 400cm. Very rarely there is a trace of a darker vertical stripe running down the front of the shoulder (as in domestic strains) but normally this is not in evidence. The hooves (see Fig. 46) are jet black (not horn coloured) and there is a conspicuous 'chestnut' (horny callous) surrounded by darker hair inside the upper part of the fore-legs. Unlike true horses, there is no 'chestnut' on the hind leg.

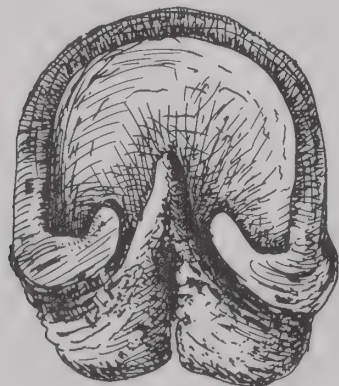


Fig. 46 Showing sole of right fore-foot of *Equus hemionus*. The hoofwall is blue-black in colour and 6–7mm in thickness. Note triangular shaped horny cushion covering heel which acts as shock absorber when travelling over hard ground.

Adults stand 110–127cm (43–50in.) at the shoulders with a body length from nose tip to rump (measured straight between pegs) of 2.06m (6ft 10in.) up to 2.11m (7ft). (Ali, 1946). An adult male weighed by Dr. Salim Ali (op. cit. 1946) was 238kg (525lb) and a female 204kg (450lb). A captive specimen has been recorded as weighing 218kg (480lb) (Crandall 1964). Females have two inguinal teats and the males only develop rudimentary tusches (canines) (see Fig. 45).

**Distribution and Status:** A remnant survived in the Great Rann of Kutch on the borders of Chacro and Nagar-Parkar tehsils of Tharparkar district in Sind up to the late 1960s. There are no reliable estimates of numbers but in the opinion of an army officer who served in that border region during the middle 1960s there were perhaps 20 individuals (Major S. A. Khan, pers. comm.). Unfortunately this very region has become of considerable strategic importance since 1965 and the presence of opposing troops on both sides of the border may well have led to further decimation of these few individuals. A young animal was actually captured and presented to a local land owner in 1968 but it did not survive. In the winter of 1969/70, two were reported as having been shot by army officers (Major S. A. Khan, pers. comm.). A former Deputy Collector from Tharparkar, whom the author subsequently met in 1965, recalled observing a band of three Onagers in about 1964 and he also saw a suitcase made from the hide of a Wild Ass which had been shot a few years before (Dr. Imtiaz Ahmed, pers. comm.). The local residents occasionally persecute this Wild Ass because of damage done



*Equus hemionus* ○ Known distribution  
 ▭ Probable range

Distribution Map 63 Asiatic Wild Ass or Onager.

to their crops, but the real danger lies from hunters in jeeps which can travel in winter, all over the hard dry surface of the Great Rann of Kutch.

In the Monsoon area the whole region is subject to shallow flooding. It is barren of any cover except isolated rocky outcrops. As regards its former distribution, there is evidence of small numbers surviving up to the 1940s in south western Baluchistan around Balgajar in the Central Mekran as well as Sohtagan in the extreme western border of Khara district. Dr. Ranjha of the Zoological Survey, considered it extinct by the 1960s in Baluchistan though he had a reliable record of an individual killed by jeep hunters in the 1950s. (Dr. Ranjha, pers. comm., and Gee, 1962). In the 1880s it was described as abundant in Baluchistan around the plains of Bampur (Murray, 1884). The Baluchistan name for the Ass, as in adjoining Iran, is 'ghor khar'. The prevalence of place names in Kalat and south western Baluchistan having the prefix or suffix ghor and khar, testifies to the extent to which the animal was familiar and widespread in former times. As recently as 1964, Lahore Zoo tried to obtain a specimen from the Game Department of Baluchistan and it was reported at the time that hunters scouring the area, saw fresh tracks though they never succeeded in seeing any animals.

At the turn of the century large herds extended up through Rajputana and into Bahawalpur area. The late Amir of Bahawalpur recalled that around 1900 when the State troops were engaged in desert manoeuvres near Bahawalnagar, that his father authorized the machine-gunning of some 70 or 80 Wild Asses to provide meat for his troops. (H. H. Sir Sadiq Mohammed Khan Abbasi, pers. comm., 1964). They were still considered plentiful in the area at that time though they must have been exterminated fairly shortly thereafter.

Reference to the Wild Ass occurring in Waziristan is conflicting. A British Museum specimen killed in 1882 is described as coming from the Sham plains in Waziristan, but the map reference cited is actually in Bugti territory in south eastern Baluchistan, viz. 20°20'N, 69°40'E (Pocock, 1927). Dr. J. Aitchison during the Afghan Boundary Commission

stated that in April 1910 in north western Afghanistan he encountered a herd estimated to number over 1000 individuals. There is no data on their present status in Afghanistan but they are believed to be nearing extinction in that country (Simon, IUCN 1966).

Extra-liminally, the Indian Ass is concentrated now only in the Little Rann of Kutch in India — a distance of approximately 130 kilometres (80 miles) from the remnant in the Great Rann of Kutch on Pakistan's border. Since the two areas are separated by cultivated high land it is unlikely that the two populations have been able to inter-mingle in recent decades. In 1970 an aerial count of the total Indian population by K. S. Dharmakumar Sinhji put the number at about 400, a considerable decline from estimates made five years earlier (Simon, IUCN, 1966, and Spillet, 1966).

**Biology:** The surviving population on the borders of Pakistan is too small to reveal much about the habits and former mode of life when it existed in larger concentrations. It is now never encountered in numbers of more than two or three individuals which seem constantly subject to local migrations. Studies of the larger population in the Little Rann of Kutch are however essentially applicable to these Pakistan animals and there have been several fairly detailed accounts. (Ali, 1946; Gee, 1962; and Spillet, 1966).

They are gregarious and very shy of human disturbance so that they take refuge by day in the barren mud-caked salt plains of the Rann, coming only at night to the edges of cultivation and the islands of higher ground on which scattered tufts of wild grass grow. In their nocturnal feeding habits they differ from the wild ass populations of the Central Asiatic uplands. In Tharparkar district of Sind in the late summer and autumn they will raid crops of sorghum (*Pennisetum typhoides*) sown after the rains as well as 'matri' (a kind of cultivated vetch) which is sown in these border regions in winter after good rains. However such visits to crops are comparatively rare, the animals subsisting mostly on natural grazing on the islands of high ground in the Rann. Here (in Tharparkar) the principal grass species is *Cyperus capillaris* which is believed to be grazed by the Wild Ass (domestic stock readily eat it) and to a lesser extent *Eragrostis cynosuroides* and *Sporobolus* species (Dr. Rehman A. Beg, pers. comm. and in lit.). In the Little Rann of Kutch the principal grass grazed was observed to be *Eleusine flagellifera* (Ali, 1946). It is noteworthy that a study of the Somali Wild Ass in Ethiopia (World Wildlife Project No. 496, Dr. H. Klingel, 1972) showed that this species also prefers grass at all times, not browse.

In Baluchistan and Afghanistan at the turn of the century, it was recorded that the Wild Ass often congregated in the autumn in large herds numbering hundreds after good rains. At other times of the year, however, the stallions tended to associate in separate small groups or to wander singly, whilst only the dominant stallions lived with small female herds and their offspring. Studies of the Somali Wild Ass (Klingel, 1972) also showed that there was no distinct social structure with herds frequently breaking up or coalescing.

The mares come into heat in August and September, at which time the stallions fight each other viciously using their teeth to grip their opponent's neck as well as rearing up and striking with their fore-feet. The dominant stallion accompanies an oestrus mare for two or three days during which period it aggressively drives off any other approaching male. The gestation period is about eleven months and in captive specimens has varied from 320 to 330 days. (Veselovsky and Volf, 1965). The foals are thus born mostly from late July to mid September, towards the end of the monsoon season, and



at a time when vegetative growth is at its maximum. The Indian and Persian Wild Asses are very hardy animals and they breed readily in captivity. Females appear to be sexually mature at about 30 months and to be capable of continuing to breed for 20 years in captivity and 14 to 15 years in the wild (Veselovsky et al., 1965, Bannikov, 1971). There are no records of more than a single foal being born at one time. Males are believed to be strong enough to dominate rival stallions and to breed successfully only from their fourth year and thereafter. The foals are usually suckled for eight to ten months, even longer if the mother does not become pregnant the following summer (Bannikov, op. cit.). At one month of age the foal begins to graze regularly for itself.

Man is the main predator on the Wild Ass, though wolves no doubt attempt to take young foals occasionally. Both young and adults are extremely fleet of foot and rely on speed to escape predation. In modern times of motorized transport the Wild Ass on Pakistan's borders has been regrettably decimated by this means — often by army personnel stationed on the border. They have been clocked running at 30 to 32 mile/hr for two or three miles without showing any

signs of fatigue (Ali, 1946) and they can in a burst of speed, reach 40 mile/hr (Bannikov, op. cit.). Studies in the Little Rann of Kutch indicate that the introduction of disease from domestic cattle poses an equally great threat to the surviving Indo-Pakistan population. Both South African horse-sickness and 'surra' are fatal to Wild Asses and endemic in the region (Gee, 1962). The former disease is spread by a virus which was first noticed in 1959, whilst 'surra' is caused by a Tripanosome blood parasite and has probably been endemic in Sind for centuries. Studies on a fresh killed young specimen from the Little Rann of Kutch revealed that they are often heavily infested with endo-parasites such as *Ascaris megalocephala* (round worms) and *Stongylus armatus*. These same parasites will infect domestic horses (Steel, 1887).

Wild Asses are relatively silent animals, but stallions will emit a shrieking bray when rounding up their herd or when approaching an oestrus female when they give a slightly different kind of call (Lydekker, 1907 and, Bannikov, 1971). A captive Onager lived 24 years, and 15 to 17 years lifespan would seem not unusual in the wild (Crandall, 1964, and Bannikov, op. cit.).

## 10 ARTIODACTYLA

The Artiodactyla have legs terminating in two functional centre toes enclosed in horny hooves of roughly equal size and giving the appearance of a single hoof split down the middle.

### SUB-ORDER SUIFORMES

#### FAMILY SUIDAE -- PIGS

Omnivorous even-toed mammals having incisors in upper and lower jaw and prominent canines. No horny projections on top of skull. The family comprises five genera of pigs or hogs confined to the Old World. They are not true ruminants having a simple stomach chamber and molar teeth which are bunodont with rounded cusps. The canines form tusks which are used for defence and intra-specific aggression. Four toes on each foot, but the outer ones are short and non-functional.

Genus *SUS* Linnaeus, 1758

#### Key to the Pakistan Species of *SUS*

Greatly elongated muzzle terminating in a flattened naked nasal disc adapted for rooting up subterranean parts of plants.  
... *Sus scrofa*

### *SUS SCROFA*

Species *Sus scrofa* Linnaeus, 1758

Subspecies *Sus scrofa cristatus* Wagner, 1839; Wild Pig or Indian Wild Boar (see Illustration 48).

**Description:** The Indian subspecies of the Wild Pig is much less hairy than the European representative and these hairs are blacker in appearance. Studies of the European wild boar (Amon, 1938) have indicated that it may itself be of mixed ancestry but it is not known if the Indo-Pakistan population is in any way genetically distinct despite their average smaller size and sparser hair covering.

An adult is a large bulky animal with a very short thick neck, deep body and rather slender legs. The head has a long sloping muzzle terminating in a special flattened disk, which is actually supported by a pair of special bones and is a very tough organ, well adapted to the animal's method of foraging, as is the short muscular neck. The large ears are pointed and set forward, being thickly fringed with hairs. The small eyes are set far back in the skull close to the base of the ears. The short tail usually terminates in a tuft of longer yellowish-brown lateral bristles. The skin colour is dark grey varying to pinkish-brown. It is sparsely covered all over with coarse black and brown bristles. Longer bristles on the nape and over the shoulders form a crest. The bristles on the lower cheeks are also longer and often a yellowish or horn colour. This striking pattern may well serve the younger males in social interaction

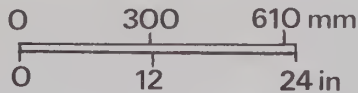


Illustration 48 *Sus scrofa*: Wild Pig or Indian Wild Boar.  
(Based on fresh killed specimen from Pirawala Forest,  
Punjab.)



with other larger males as the lighter colour simulates tusks. Young pigs are a lighter reddish-tan colour, marked conspicuously along the flanks with 3 or 4 creamy-buff stripes interspersed with dark brown or blackish hairs. These horizontal stripes gradually disappear as the young pigs reach two months of age but even thereafter their general body colouration is more reddish-brown than that of the adults.

In adult males the canines become greatly developed into tusks. Those in the upper (maxillary) jaw are comparatively shorter and thicker and fit closely behind the lower (mandibular) tusk which curve forwards and outwards (see Fig. 47). Even in mature boars the lower canine hardly extends more than 7.5–10cm (3–4in.) outside the jaw but its roots extend inside the lower mandible for up to three quarters of its length, so that the complete extracted teeth may measure 25.5cm (10in.) along the outside curve. One such pair of tusks from an aged boar shot at Batapur (near the Ravi river) by Mr. Krebb in the mid 1960s actually measured 230mm (9in.) and each tooth encompassed an almost complete 360° arc. Another pair of tusks shot from the same region secured by the same hunter, were less symmetrical but the largest one measured 270mm (10½in.) over the outside curve. In older males these tusks often crack and get blackened with tartar. Canine teeth are much less massively developed in the females.

The head and body length of adults varies from 115–150cm (45.5–59in.) measured straight between pegs with the tail generally under 18–23cm (7–9in.) in length. Males are considerably larger and heavier than females and may stand 84–91.5cm (33–36in.) at the shoulder. In studies around Lyallpur region the largest male, estimated to be between four and six years old, weighed 238lb but it was not an exceptionally big animal (Taber et al., 1968). During an organized beat for wild pig in Bahawalnagar district in the early 1960s

the largest male out of some 110 animals killed, weighed 145kg (320lb) (Lieut. General J. Marden, pers. comm.). Larger boars have been measured in India. A 160kg (350lb) specimen from Nagpore stood 96.5cm (38in.) at the shoulder, with 21.6cm (8½in.) tusks (Richardson, 1890). In Central India, Dunbar Brander (1931) records the heaviest male as weighing 165kg (364lb) and the maximum tusk length as 25.5cm (10in.). The European boar certainly reaches larger weights even in the Middle East and a large boar killed in Iraq is recorded as weighing 227kg (500lb) (Page, 1954).

**Distribution and Status:** Though they are very adaptable they need thick cover in which to shelter and lie up during the day, whether in the form of reeds, thorny bushes or tall grasses. They avoid arid mountainous regions and are most typically associated with the Indus basin riverain tracts having thickets of *Saccharum munja* and *S. spontaneum* grasses. In well cultivated settled regions they have adapted well to irrigated forest plantations. They do not penetrate far into sand-dune desert areas but ascend the outer Himalayan foothills.

The Wild Boar is found up to 3000ft elevation in the Margalla Hills and around Kahuta and Tret in the Murree foothills and throughout the Punjab and Sind down to the Indus mouth. It occurs west of the Indus around Peshawar, Mardan, Bannu and Dera Ismail Khan and the increase in sugar cane cultivation has favoured the species in these latter regions, the boars finding shelter in the standing crops. A very small number have penetrated the arid mountainous regions in the North West Frontier Province as well as Baluchistan where they are confined to scrub jungle in the vicinity of stream beds and the broader valleys. They have not penetrated into the Himalayan ranges. It occurs in the southern part of Chitral

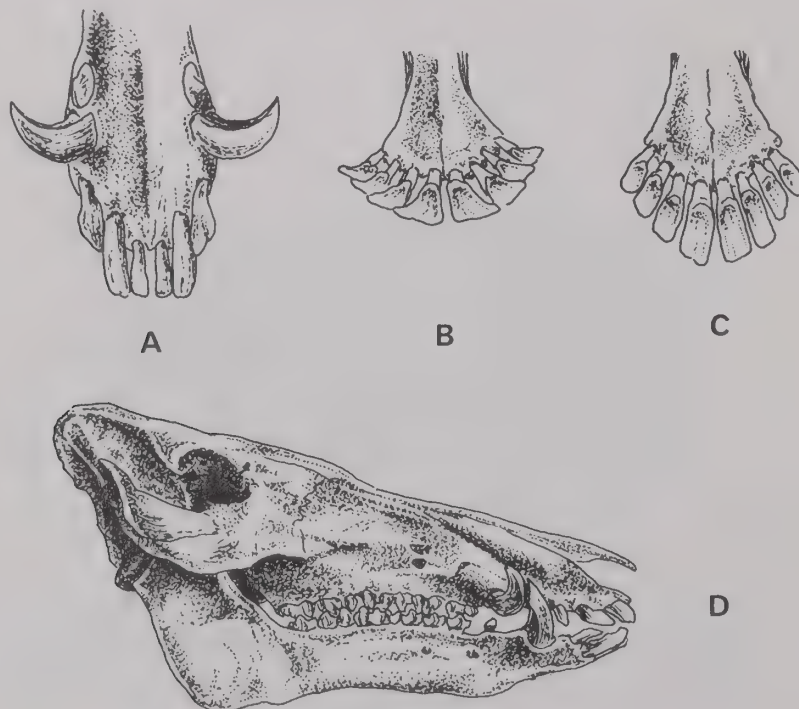


Fig. 47 Showing difference between dentition of lower jaw of *Suidae* and *Bovidae*.

- A. Lower jaw of adult male *Sus scrofa*. Note three pairs incisors with enlarged canines forming tusks and one pre-molar close to the canine.
- B. Lower jaw *Gazella subgutturosa*. Note canine

modified to form outer fourth pair of incisor-like teeth.

- C. Lower jaw of *Capra hircus*.
- D. Lateral view of skull of male *Sus scrofa* showing development of tusks and bunodont, cheek teeth.

*Sus scrofa*

Distribution Map 64 Wild Boar or Indian Wild Pig.

valley (Fulton, 1903). It is comparatively rare in the Salt Range but occurs in the Kala Chitta Hills of Campbellpur district.

The spread of irrigation in Pakistan and the development of irrigated forest plantations has favoured the increase of wild boars in the Punjab, where they became a serious agricultural menace during the 1950s and 1960s. The present position is rather different in the province of Sind, since the shrinking of the riverain forests due to control of Indus river flooding, clearance of jungle in the East Nara and Sanghar regions and decrease of rice cultivation in the Indus delta, have all apparently led to a sharp decline in the wild pig population (Chief Minister Mumtaz A. Bhutto, pers. comm., 1972). The persistent drought in the early 1970s has also led to increased grazing pressure and disturbance in the riverain tracts and irrigated forest plantations of the Punjab and there is sufficient evidence for believing that their numbers have recently declined.

During a wild boar extermination campaign in 1962 the wild boar population was estimated to be greatest in Mianwali district, probably because of the extensive development of irrigated forest plantations in the comparatively unpopulated Thal desert region. In the oldest forest plantation at Changa Manga, long a stronghold of wild life, the Wild Boar population was fairly carefully censused at 27 per square mile with a total of 467 individuals in the late 1960s (Inayatullah Chaudhry, Wild Life Management Specialist, Pakistan Forest Institute, unpublished ms.)

The Government has actively pursued a policy of Wild Boar extermination using grain baited with *Endrin* and *Folidol* (organophosphatic insecticides), as well as development of swine fever cultures and inoculation and release of wild caught pigs. Techniques in this later procedure have been refined recently and there is evidence that the Changa Manga forest population was almost entirely exterminated by this method in 1971. However they are fecund animals, as well as being adaptable and resourceful. Since most Muslims refuse to have anything to do with them, they are still a serious pest to agricultural crops in many localities, particularly adjacent to riverain forest. Because of their highly developed sense of

smell, poisoning campaigns have also not been very successful and have in fact done more serious harm to the other wild life populations.

**Biology:** Wild pigs are normally social animals, resting and feeding in small groups, though adult males will usually forage and lie up individually. They are largely nocturnal in feeding activity but can be usually seen emerging well before dusk and often crossing through quite open country. In areas where they are not disturbed they may even forage during the day and I have encountered feeding pigs in the reed beds by Trimmu Headworks (Chenab river — Punjab) in mid afternoon.

Because of their sparse hair covering they are probably sensitive to intense sun and they spend the day in the densest cover they can find and frequently resort to mud wallows if available. It has been reported that they will sometimes chop grass and spread it in a rough heap and then burrow under this so as to shelter their bodies during the day (Dunbar Brander, 1931). Their hearing, as well as sense of smell, is acute, but it is possible to surprise a sleeping animal. On one such occasion in a *Saccharum* thicket near the Jhelum river, a large wild pig was encountered, snoring audibly, and was approached to within 3m (10ft) whereupon it burst away in tremendous panic (R. F. Nana, pers. comm., 1969). Apparently it is no coincidence that a similar incident was recorded by W. A. Thesiger during his sojourn in the marshes of the Tigris (Thesiger, 1964).

Wild pigs have a number of vocalizations and are inclined to be rather noisy in consonance with their fearless disposition. When a group is feeding peacefully they regularly communicate to each other with guttural grunts. Both sexes when aware of danger or surprised will give a staccato snort, not unlike the 'whoof' of a dog. When disturbed I have heard them give rapid very low grunts, and an adult male will clatter his tusks together in an audible and menacing manner when angry and about to attack. Their sense of smell is particularly acute and they find their preferred foods by this means. They have a strong rather acrid body smell which is especially noticeable when they have been lying up during the day. This body smell may be a factor in maintaining social contact. They do not rely on their weak eyesight to detect danger but rather upon their sense of smell. If wild pigs are encountered in forest or thick cover, they will often approach more closely after first sighting, as if to pick up the scent and determine if the imperfectly observed intruder represents danger or not. They are bold and fearless in the presence of most animals, including humans, and it is well known that if they are surprised suddenly at close quarters their immediate reaction is to attack.

Though omnivorous, they are largely vegetarian in diet. They will consume a wide variety of seeds, fruits, young leaves, tubers and succulent stems as well as fungi, carrion, birds' eggs, reptiles and insect larvae. Their preferred food however seems to be succulent roots and rhizomatous stems for which they will dig diligently even in astonishingly hard ground, and they rarely eat green vegetation growing on the surface. In their digging they certainly eat any insects, lizards or even rodents which they might be able to surprise. In 1974 I came across shallow tunnels of a mole rat (probably *Bandicota bengalensis*) which had been deliberately excavated by a wild pig for a length of about 9ft, apparently in order to kill and eat the rodent. This was in wet ground on the margin of Mehboob Lake, Sujawal division of Thatta Distt. I have observed in the East Nara swamps that wild pig rapidly consume any domestic cow or buffalo which may have died from natural causes away from the village. They are also very fond



of ripe fallen fruits of the ber (*Zizyphus*) and mulberry (*Morus alba*). They can be very destructive of farm crops, particularly potatoes, and ripe sugarcane, trampling far more than they actually consume. Wheat is particularly subject to their depredation at two stages. When freshly sown and until it sprouts, they will open dead straight furrows with their snouts eating all the grain deposited by the seed drill, doing this so precisely that it is hard to imagine such parallel open furrows were not made mechanically. Again when the ripening wheat grains are at the milky stage, provided the ears are not awned, Wild Pigs like to chew the panicles but show no interest in it once the grain sets hard. They also chew rice panicles at the same stage of development. In 1970 near Khanewal, a one acre experimental plot of awnless wheat (Dirk variety) was sown within (sic) a 50 acre plot of bearded varieties (*Mexi-Pak*). When the grains were half ripe, this plot was visited for five or six successive nights by an ever-increasing number of Wild Pigs until the entire acre was reduced to a tangled quagmire, whilst the adjoining bearded wheat crop was left upstanding and untouched. It was estimated that over 30 pigs visited this wheat in one night.

In the subcontinent of India studies have shown that the breeding of the Wild Pig can occur throughout the year but that there is probably a peak breeding period during the monsoon season (Dunbar Brander, 1931, Prater, 1965). In Pakistan most litters are born between July and October and I have come across no evidence yet of litters born outside of this season. In the dry north west feeding conditions are at their optimum during the monsoon season, with an abundance of succulent vegetative growth and insect life, and it seems likely that the breeding cycle has become adapted to the harsh climatic conditions of this region. Major I. Grimwood (pers. comm.) has observed that Wart Hogs (*Phacochoerus aethiopicus*) have sharply-defined and regulated breeding cycles according to the incidence of the rainy season. Thus in Zambia, the rut occurs in the first half of July whereas in Kenya the breeding season is much more extended and young can be born most months of the year. The gestation period is about  $15\frac{1}{2}$  weeks and observations in Pirawala plantation (south west Punjab) over a number of years show that the majority of litters are born in July and August, and the youngest or latest litter ever seen by me was estimated to have been born in early October. Females have irregular numbers of mammae, varying from eight to twelve, although five pairs is most normal. In a study in Lyallpur region, it was revealed that females produce their first litter between the ages of twelve months up to nearly two years (Taber, 1968) and four seemed to be the average litter size which survived more than a few days after parturition. In India average litter sizes are stated to be four to six (Prater, 1965). As in the European Wild Pig, the female builds a rough nest by cutting grass and leaves and heaping this together, and the young are born in this nest which usually is well concealed in a thicket of thorny bushes or reeds. The young rapidly become active, being able to run around within an hour or two of birth. As soon as they are strong enough to forage far afield the young accompany their mothers, and usually two or three sows form one herd or sounder, with their litters combining in a mixed nursery group of different ages and sizes. The biggest such group observed in Pirawala consisted of 15 youngsters, including five which appeared to be at least  $1\frac{1}{2}$  months older than the five smallest and apparently youngest litter. Smaller groups consisting of two combined litters are more usual and it is not known if they keep together after the young are more than two to three months of age. I have one observation of a sow with a litter of eight piglets apparently all her own, but in

Pirawala Plantation (22,000 acres) many litters consisted of no more than two or three young, and this seems to indicate that mortality may be quite high amongst newly born pigs.

Wild Pigs are the favourite food of the larger carnivores, but in Pakistan the absence of any significant population of such carnivores leaves wild pigs with no natural predators except man. They are not traditionally hunted in most regions because of the Muslims' abhorrence of this animal. They are, furthermore, quite fearless in the presence of humans and wild boars have long been recognized as dangerous and aggressive animals worthy of the huntsman's skill. In 1969, at Khanewal, there were three separate cases of men being seriously attacked within the space of four months. Only in one case where the man was armed with a gun did he escape injury to himself. In a second case, the wild boar made an unprovoked attack just at dusk on a passing man, and it was found that this boar was at the time being pursued and hunted by a party of men with dogs. The man received severe lacerations about the chest and shoulders. The third instance is believed to have been the result of a boar having earlier sustained minor gunshot injuries. It was a large male lying up in a field of cotton sticks in which the cultivator had entered to cut and remove the stalks. At 3.30pm he disturbed the lying boar, which not only injured him fatally but was reported by those who came to the rescue to be chewing on the man's arm as he lay. By his own testimony, the cultivator before he died described how he had attempted to drive off the boar with the small axe which he was using to chop the cotton sticks.

In captivity the Indian Wild Boar at Calcutta Zoo has lived for 20 years (Dover 1933) but presumably in the wild 10 to 12 years might be an exceptional life span. It is believed that the males do not reach sexual maturity until their third year and they certainly continue growing up to their fourth year as revealed in the Lyallpur investigation (Taber, 1968).

### Sub-order RUMINANTIA

The males with some form of horn, born on bony pedicles or cores, teeth selenodont and specialized for grinding food with a sideways motion. Multi-chambered stomach, and digestive process which involves regurgitation of partly digested food and cud-chewing.

### FAMILY CERVIDAE—DEER

This family comprising the deer, occurs in North and South America, throughout Europe, Russia and South East Asia, but except for the extreme north western part of Africa the deer have not spread into the Ethiopian faunal region, which remains the stronghold of the Bovidae. The most striking characteristic of the family is the horns which are generally branched and referred to as antlers. With the exception of the Caribou and Reindeer (*Rangifer* spp.) only the males bear antlers. These attain massive proportions in some species yet the surprising thing is that they are deciduous. Each year after the rut season is over the male sheds or loses these antlers and completely fresh horn growth starts. Generally young animals have smaller antlers consisting of short straight spikes without branches and they reach their full development when the Deer is in the prime of life. The Cervidae are also characterized by having prominent pit glands below the eye.

**Key to the Family Cervidae**

No incisors in upper jaw but canine teeth usually present in males. Nostrils set in moist naked rhinarium. Males usually with horns which are branched and deciduous. Females usually without horns.

**SUBFAMILY MOSCHINAE — MUSK DEER****Genus MOSCHUS Linnaeus, 1758****Key to the Pakistan Species of MOSCHUS**

Both sexes hornless. Males having greatly elongated incisors in upper jaw (see Fig. 48), and purse-like scent gland situated anterior to prepuce.

... *Moschus moschiferus*

**MOSCHUS MOSCHIFERUS**

*Moschus moschiferus* Linnaeus, 1758; Musk Deer  
(see Illustration 49).

**Taxonomy:** This monotypic genus is so markedly different from the other genera of Cervidae, that it has been placed in a separate subfamily. Besides the complete absence of horns in both sexes, they possess a gall bladder in the liver, and the females have only two mammae. All other Cervidae possess a gall bladder and the females two pairs of teats. These features are thought to indicate a more primitive phylogenetic origin. In *Moschus* the female only develops a tiny vestigial canine tooth which is often shed with age. In all other genera, even where the canine is not particularly enlarged in the males, both sexes have canines.

**Description:** No larger than a medium sized dog, this little deer has a peculiar speckled coarse fur, hind legs longer than the fore, a high arched spine and conspicuous upstanding ears which are rounded in outline and thickly fringed on the inside with white hairs. The ears are often the most noticeable feature when it is encountered in the wild (see Fig. 49).

Due to the rump being higher than the shoulders and the spine arched, it resembles the Goral (*Naemorhedus goral*) in outline but the legs are slimmer and the hooves noticeably pointed and compressed. The pastern is rather long and sloping with the outer rudimentary toes (second and fifth) terminating in conspicuously sharp pointed hooves. These hooves are almost equal in length to the third and fourth, or central toes, and are thus more developed than in most *Artiodactyla*.

Their outer toes normally come into contact with the ground when the animal is walking or running and they possess a well developed musculature so that they can be widely distended (Flerov, 1952). This is no doubt a valuable ecological adaptation to support the animal when traversing deep snow, as well as in helping it to slide down steep rocky surfaces.

The general body colour is rather variable, from dark sepia brownish to paler iron-grey, with the lower cheeks, throat and belly being whitish. In summer coat the fur tends to be darker, inclining to dark chocolate brown colour and in winter there is more grey speckling. Most specimens in summer coat show two or three indistinct horizontal rows of pale creamy spots extending from behind the shoulders to the pelvic region. In young Musk Deer this spotting is more extensive, spreading even to the lower flanks. In winter coat in adults these spots are not visible.

The hair of the body is peculiar, lacking any underwool but being very coarse and pithy in texture. It is also brittle and the hairs break off easily. Individual hairs are whitish at the base with dark brown tips and have a regular wavy outline in their thickened proximal region (see Fig. 49). When examined microscopically they are found to be hollow tubes. The hairs on the lower flanks and caudal region are particularly thick and coarse.

The tail, a mere stump up to 38–50mm (1½in.) long, is completely buried in the fur of the caudal region. In the male it is semi-naked in its proximal part with a slit shaped gland on the ventral surface and terminating in a small terminal hair tuft. Females lack this slit gland, their tails being more slender and uniformly hair covered. A thick greasy unpleasant smelling fluid is reported to be continuously secreted from this gland in adult males (Jerdon, 1874).

The eyes are large with a golden brown iris, and the rhinarium is naked black and always moist. Adult males have downward curving, laterally compressed canine teeth which are greatly elongated even below the lower jaw. A record pair of such tusks extended over 75mm (3in.) in a straight line but the measurement over the curve is not given (Lydekker, 1907). A specimen in the Bombay Natural History Society Collection had upper canines measuring 85mm (3⅜in.) along the outside curve and extending for 55mm (2¼in.) when measured in a straight line from the upper palate. An adult male from Gilgit had the ear length 9.4cm (3¾in.) the tail 38mm (1½in.) long, and the total body length 94cm (37in.). It weighed 11kg (24lb) and stood 53cm (21in.) at the shoulder. Another specimen from India is described as standing 62cm (24.5in.) at the shoulder and 67cm (26.5in.) high over the pelvis (Stockley, 1926).

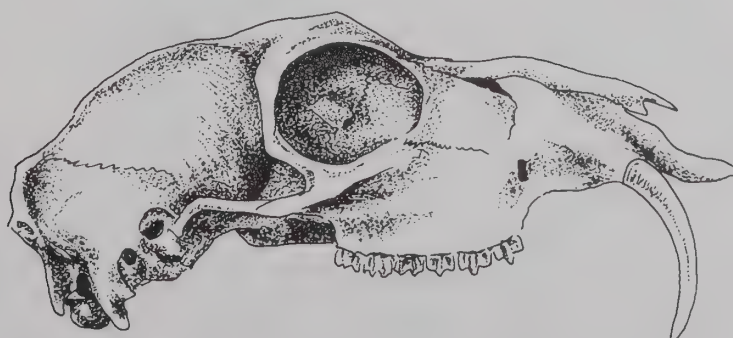


Fig. 48 Showing lateral view skull of *Moschus moschiferus*. Note greatly elongated upper canine teeth and absence of lachrymal pit in front of eye.



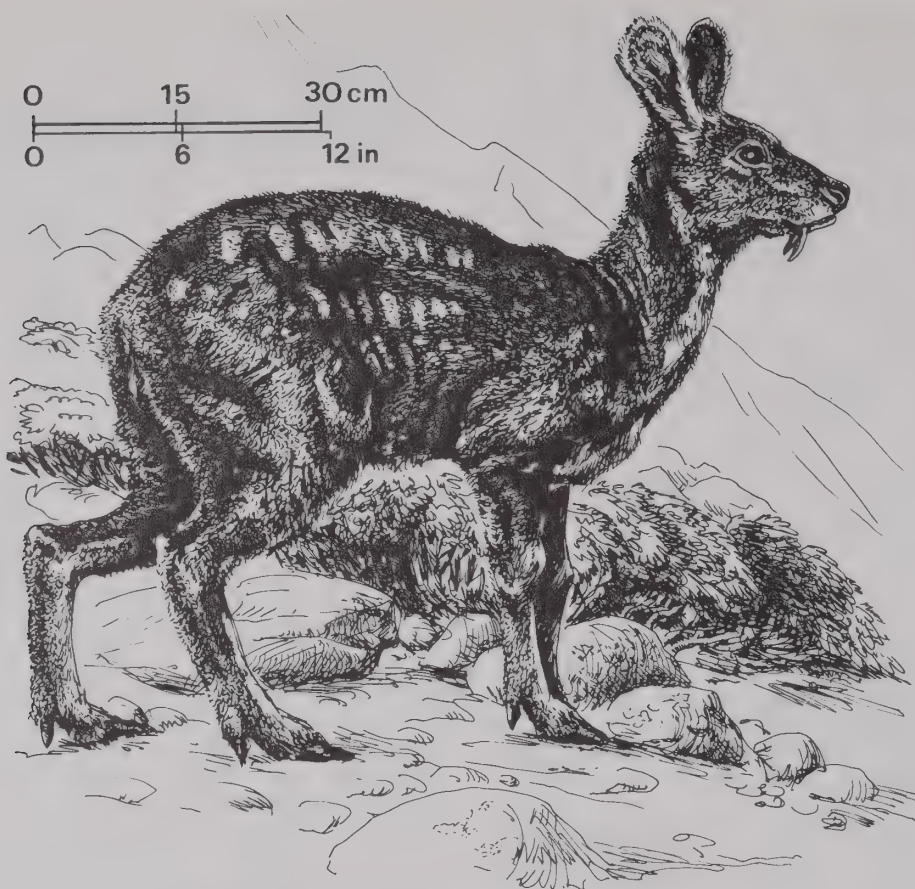


Illustration 49 *Moschus moschiferus*: Musk Deer. (Based on photographs in possession of Z. B. Mirza, sub-adult specimen from Naran, Hazara District and study specimens from the Bombay Natural History Society collection and British Museum from Gilgit and Kashmir.)

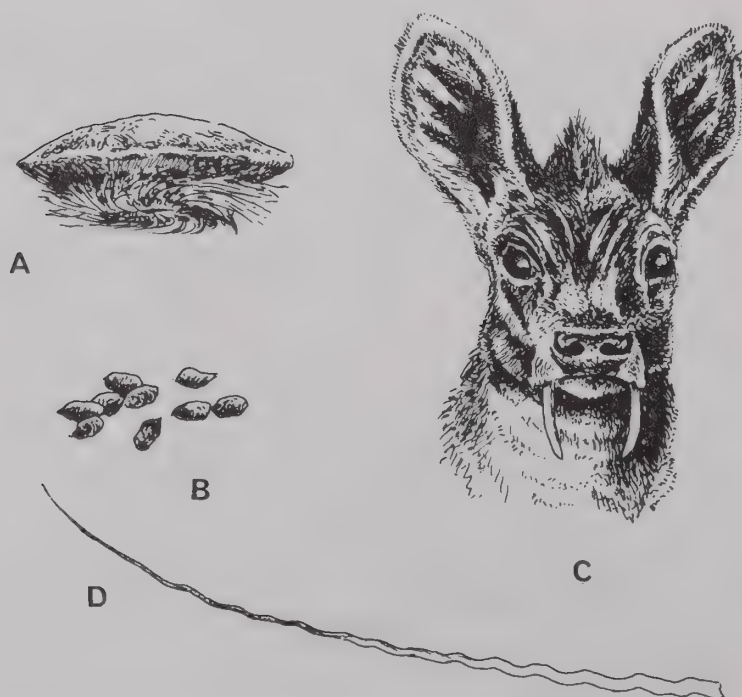


Fig. 49 Showing features of Musk Deer.

- A. Lateral view of musk gland. Note external orifice underneath pouch surrounded by whorl of hairs.  
 B. Characteristic appearance of faecal pellets, approx-

imately one-third actual size.

- C. Front view of head of male musk deer showing canine tusks.  
 D. Hair from lower flanks approx.  $2\frac{1}{2}$  x actual size.

Unlike all the other Cervidae, there is no pit gland below the eye nor any pedal glands on the feet in this species. The feature from which it derives its name, is the large abdominal scent gland developed in the males after they attain three years of age. This is in the form of a roughly circular pouch under the skin in the lower region of the belly just in front of the prepuce. Externally, this gland is marked by a whorl of pithy hairs. It measures about 5cm (2in.) in diameter and 3cm in width and is elliptical in cross section (see Fig. 49). When dried it emits a rather pleasant scent reminiscent to the author of stale perfumed cigarette smoke. When fresh, the musk secretion is reported to be pungent and of unpleasant odour (Prater, 1965). It is only during the rutting season that this gland secretes any quantity of musk at which time up to 30g of thick oily musk can be collected from adult males. The animal is hunted ruthlessly for its musk pod at all seasons of the year, because of its value as a fixative for perfumes. In Chitral bazaar in 1967 it was alleged by local traders that one such pod was worth Rs.750.00.

**Distribution and Status:** In the north west Himalayas it is associated with the sub-alpine scrub zone, above coniferous forest. It particularly favours steep slopes and narrow gullies near mountain crests where winter snows provide sufficient

It is known in Chitral but now considered very rare throughout the State and at no time did it spread to any great extent west of the main Chitral valley (Col. Khush Wakht, pers. comm., 1970). In the early 1960s it still occurred in the southern part of Chitral in the higher mountain ranges east of Drosh (Major S. A. Khan, pers. comm.). It also occurs in the remoter upland valleys in the northern regions of Hazara district, Indus Kohistan, and Gilgit. In the late 1960s it was still considered not uncommon around Astor and in the high plateau region on the east bank of the Astor river (Brig. Aslam Khan, pers. comm., 1967). In 1966 it appeared not uncommon in birch forest above 3000m beyond Kargah village and it also occurs in Chilas district of Gilgit and in the Darel range.

A young captive male was seen at Naran in the Kaghan valley in August 1966 (Z. B. Mirza, pers. comm.). It is believed to be still widespread in Baltistan particularly around the Hushe Valley in Juniper scrub.

In the early 1930s it could still be found on the summit of Mukshpuri in the Murree Hills (Hamid Khan, retired Inspector of Police, pers. comm., 1965). It is long since extinct in the Murree Hills.

Extra-limitally, it extends across the Himalayas to Nepal, Sikkim, South West China, Tibet and up to north eastern Siberia in the Ussuri region of Russia. In fact it is found throughout the boreal forest zone of Russia, wherever there are mountains (Flint et al., 1965).

In the more accessible Himalayan regions, such as Chitral and Hazara district, it has obviously become excessively rare due to constant persecution by hunters. Its chances of survival in the remote but much less favourable arid plateaus of Baltistan are better, but if it is to have any chance of future survival in most regions of Pakistan it should be totally protected.

**Biology:** This is a shy and secretive animal in the Himalayas and there are no detailed accounts of its behaviour or habits though the Siberian population has been better studied by Russian zoologists (Heptner et al., 1966, and Flerov, 1952).

It is solitary in habits and seems to be territorial, regularly frequenting a particular bit of ground. Captive animals in a large enclosure were observed habitually to use the same paths, generally an indication of territorial habits (Kirchshofer, 1972). They have a habit of regularly depositing their faeces in the same places, and these characteristically elongated pellets are easy to recognize (see Fig. 49). Such faecal accumulations in other ungulates are associated with a tendency to occupy a fixed territory. Musk Deer spend most of the day lying up in some sheltered thicket, and forage actively only during the early morning and late afternoon. The regions where they live are generally carpeted with snow from October up to April so that living conditions are harsh and their peculiar pithy hair must provide a very efficient thermal barrier despite the absence of underwool. In summer they feed on all kinds of herbs, young leaves and grasses. In winter they have to resort to eating the bark and twigs of willow (*Salix himalayensis*), wild currant (*Ribes emodense*) and honeysuckle (*Lonicera heterophylla*) which grows at these elevations, and also consuming the lichen off rocks and larger tree boles. Probably their very sharp hooves assist them in digging in the snow to expose vegetation. Russian studies show that in winter they will subsist mostly on moss and lichens (Flerov, 1952, and Flint et al., 1965) and in Gilgit, where the tumbled rocks are covered with a variety of lichens even at 12,000ft elevation, these must also provide a vital food source.

The rut takes place in November and December and only at this time will two or more non-related individuals be en-



Distribution Map 65 Musk Deer.

moisture in spring for growth of stunted bushes such as the wild currant (*Ribena* sp.), wild celery (*Ferula* sp.) and dwarf juniper thickets. Even in mid winter it remains at high elevations, and in Pakistan usually above the 3000m (10,000ft) contour. In summer it occurs mostly between 3350m (11,000ft) and 4000m (13,000ft) in association with Birch scrub (*Betula utilis*) and in Gilgit particularly in association with dwarf Juniper (*Juniperus polycarpus*).

The Musk Deer has probably never been as plentiful in the north western part of the Himalayas as in regions further east where it is able to subsist at lower elevations because of the higher rainfall and greater vegetative cover.



countered together. Males fight during the rut period and ceaselessly pursue the females. It is not unusual to see deep slash marks in the brittle fur of adult males at this season and after the rut, as they fight with their canines. Males are reported to be highly excited and even ferocious during the rut, and to eat very little throughout this period (Flerov, op. cit.). They also smell penetratingly of musk during the rut period and rub their caudal scent glands against twigs and stones to mark their territory (Kirchshofer, 1972).

The gestation period is believed to be 160 days (Walker et al., 1964). Russian authorities consider the gestation period to be 5 months (Flerov, op. cit.). The young are born in late May and early June. They are small and weak at birth and it is believed that the period of suckling is relatively extended. Females become sexually mature at 18 months of age and males at three years of age (Flerov, 1952). Usually only one young is produced though twins have been reported occasionally (Prater, 1965).

The only vocalizations recorded are a loud 'hiss' (Lydekker, 1907) or a 'hoarse peeping' (Flerov, 1952) and both sexes are said to use this call. Their alarm call is said to be a 'chirp'. When disturbed, Musk Deer bound away with long erratic leaps, either up hill or down, despite the steep and difficult terrain where they are found. They display remarkable agility and are well able to traverse over huge rocks.

Man is probably the most serious predator on this little deer, because of the high value of its musk pod, but they must also occasionally fall victim to Snow Leopards and Wolves, both of which frequent exactly the same habitat in Pakistan. Their young must be susceptible to predation from Martens, Lynxes and even Golden Eagles.

## SUBFAMILY MONTIACINAE — BARKING DEER

### Key to the Subfamily MONTIACINAE

Skull with lachrymal pits (see Fig. 50). Males with small antlers having two branches and borne on long hair covered bony pedicles which also extend down the front of the face in bony ridges. Tusk-like canines in males and glands under the chin.

### Genus MONTIACUS<sup>1</sup> Rafinesque, 1815

#### Key to the Pakistan Species of MONTIACUS

Body fur short, glossy and bright chestnut. Shoulder height 40–60cm. Antlers rarely larger than 7cm.

... *Muntiacus muntjak*

### MONTIACUS MUNTJAK

*Muntiacus muntjak* Zimmermann, 1780; Indian Muntjac or Barking Deer (see Illustration 50).

**Description:** The short dainty legs make this little deer look rather heavy bodied. In contrast to the Musk Deer the outer vestigial hooves are hardly developed at all and may even be entirely lacking. Adults stand 41–60cm (16–23.5in.) high at the shoulder with body length 80–100cm (31½–39½in.), measured from nose to root of the tail. The tail is 11–18cm (4½–7in.) long. There is some divergence in weights given for typical specimens. A large sized buck in Central India is reported as weighing up to 22kg (48lb) whilst the

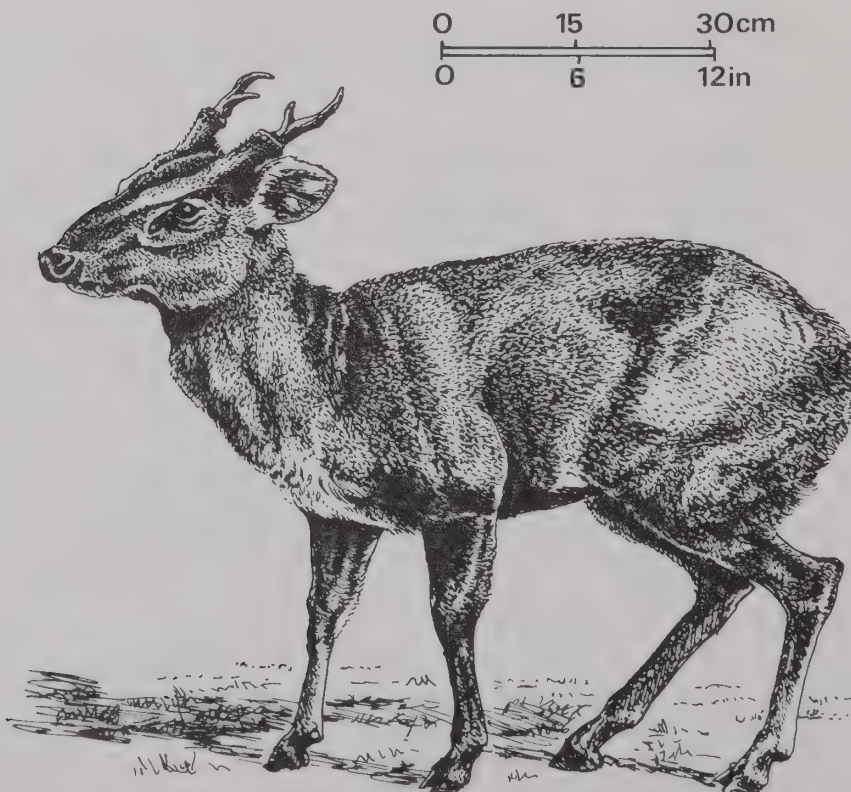


Illustration 50 *Muntiacus muntjak*: Muntjac or Barking Deer. (Based on live captive specimens in Lahore Zoo from Bangladesh. Horns based on adult male, Margalla Hills, shot by J. Ainsworth Harrison.)

female weighs 15kg (33lb) (Dunbar Brander 1931). An earlier authority gave the maximum weight of bucks as 34kg (75lb) with females up to 27kg (60lb) (Shortridge, 1914), whilst the weight range of 14–18kg given by the authors of *Mammals of the World* (Walker et al., 1964) seems too low.

The body fur is short, soft and highly glossy with no under fur and it is generally a bright yellowish-red colour varying to darker reddish-chestnut, with the throat, belly and inner side of the legs being whitish. The appearance of the head is very characteristic. The male develops two long bony pedicles covered with skin and from these the short horns are borne. Extending down from the base of these pedicles and the front of the skull are two bony ridges (see Fig. 50). These have given rise to the name Rib Faced Deer often used by earlier sportsmen (Lydekker, 1907). The horns themselves in adult males rarely reach more than 165mm (6½in.) in length and apart from a short brow tine, consist of a single unbranched spike – usually inward curving at its tip. The pedicles normally extend from 7.5 to 10cm (3–4in.) above the crown and are covered

forest. This distribution affords a perfect illustration of the significance of this zone as an avenue of invasion for truly oriental species into the dry north west. It is associated with a dense, low thorn scrub of 'Phalai' (*Acacia modesta*), wild olive (*Olea cuspidata*) with an understorey of *Zizyphus mauritiana* and does not ascend above 4000ft, nor is it associated with the tropical pine forest zone.

It is mainly found in the Margalla Hills from behind Nurpur Shahan up to Chattar. There is some doubt as to whether they still survive in the hills between Lehtrar and Kahuta though the animal is certainly known to the local villagers in these regions and occurred up to the early 1950s. They have not been recorded west of the Margalla Hills but are still found in small numbers in Azad Kashmir at Sagian and Sapalahi, also at Nawan, and Malkal, all in the Jhelum valley (Wildlife Enquiry Committee, Government of Pakistan, 1969).

It is a miracle that this little deer has been able to survive in such a limited region which is subject to increasing human



Fig. 50 Showing skull of *Muntiacus muntjak*, adult male. Note prominent lachrymal pit anterior to orbital socket with enlarged but relatively broad maxillary canine teeth, also bony horn pedicles approximately equal in length to deciduous antlers.

with thick rubbery skin terminating in a tuft of darker hairs at the tip. Their horns are shed annually, usually in May or June. Females also develop much shorter hair covered bony pedicles at the top of the skull and these also terminate in tufts of darker hair. The males develop very sharp elongated upper canines which curve downwards and outwards. These are shorter and relatively broader than the tusks of the male Musk Deer being generally up to 25mm (1in.) long so that they rarely protrude below the lip. Females also develop small tusks in the upper jaw and both sexes are reported to be capable of inflicting severe injuries with these tusks when defending themselves or their fawns against smaller predators. There is a moist black rhinarium and there is a deep pit gland below the eye, as well as tufts of hair under the chin marking a pair of glands. The ear is a large well rounded oval.

**Distribution and Status:** In Pakistan the Muntjac is very restricted in range being confined to the Himalayan foothill zone where there is some remnant of tropical dry deciduous

disturbance, such as grass cutting and grazing, besides hunting with trained dogs. In 1972 it was still estimated that 20 or 30 individuals survived within the Margalla National Park boundary and as many as 10 were flushed during one day's hunting for Wild Boar in October 1971 in this same region (Ainsworth Harrison, pers. comm., 1971). Its future survival in Pakistan in such a limited and restricted biotope is obviously very doubtful unless hunting is also restricted in all the areas adjacent to the Margalla National Park.

The Muntjac occurs throughout the Indian subcontinent in thickly wooded areas from the Nilgiri Hills in the south, Ceylon and up to the Himalayan foothills. There are no records of it having spread to the USSR or Afghanistan.

**Biology:** Being so restricted in distribution and rare in Pakistan, there appear to be no recorded observations of local populations. Based upon knowledge of the more plentiful population in the more humid monsoon forest areas of India, their habits are however, fairly well known.





*Muntiacus muntjak* ■  
*Cervus elaphus hanglu* ● Locality where *Cervus elaphus* was shot in 1955 and where a few were reported in 1972  
*Cervus duvauceli* □ Former range

Distribution Map 66 Barking Deer or Muntjac.  
 Hangul or Kashmir Stag.  
 Swamp Deer or Barasingha.

They are not gregarious or social and outside of the rutting season each leads a solitary existence. They are very shy and secretive and though individuals stick closely to a particular territory all their lives, they are seldom seen. Their elongated faecal pellets are often deposited in regular places, revealing the territory frequented by each individual. They are nocturnal in feeding activity though in undisturbed areas may start foraging in the evening before darkness falls. By day, they lie up in the densest thorny thicket they can find, but they seem to prefer the tops of rocky ridges for resting and avoid ravine bottoms despite the fact that vegetative cover in such places is often much thicker. They will lie close even when fodder cutters and local villagers are in the near vicinity but if finally disturbed by too close an approach will slip off quietly rather than bounding away in the conspicuous manner of many other deer.

They are reputed to be dainty selective feeders, but seem well able to subsist as much on browse as grasses. They particularly like the ripe fallen fruits of various wild figs (*Ficus* spp.) the fleshy flowers of the cymbal (*Salmaalina malabarica*) and the ber fruit (*Z. mauritiana*) all of which grow in the Margalla ravines frequented by this deer. They probably eat a variety of leaves of bushes as well as flowers and fruits, and a pet Muntjac was observed to search for and eat hens' eggs (Stern-dale, 1884) whilst another pet was found to be fond of raw meat (Dunbar Brander, 1931). Wild Muntjacs probably do not spurn carrion or partridge eggs when encountered. Being true ruminants they can assimilate bulky fibrous herbage and spend the day time while they are lying up, in chewing the cud. Several writers have commented upon their extraordinary long tongue — a helpful development in a browsing animal (Jerdon, 1874; Stockley, 1928; and Dunbar Brander, 1931).

The rut is believed to occur in the early winter according to the observations of local hill men in the Margalla Hills. During this time males will fight each other, slashing with

their tusks and often inflicting deep cuts (Dunbar Brander, 1931, and Crandall, 1964). The gestation period is believed to be about 180 days with a single young being born in February and March. However there is probably no very fixed breeding season and evidence from talking to local hunters is conflicting, with observations of young fawns throughout the spring and summer months. A captive herd of Muntjac at Regents Park Zoo produced young every month of the year except January (Zuckerman, 1953), and there is accumulated evidence to indicate that tropical deer and antelope species do not adapt or modify their breeding cycle markedly when transported to temperate zones (Schaller, 1967).

The young fawn has white spots over its body, and these do not disappear until they are about six months old. During the rut the males frequently call in the late evening and early morning for prolonged periods. The sound which has been likened to a squealing bark consists of a single call repeated at regular intervals and is a slightly more drawn out version of the sharp staccato bark which is their alarm call. When disturbed and in flight, they also often emit a rapid clicking noise, the origins of which have been the subject of much controversy between hunters. It is now generally accepted that this call is produced vocally — and is another version of an alarm signal (Osmaston, 1928; Frei, 1926; Burton, 1929; and Dunbar Brander, op. cit.).

In Pakistan the Muntjac is much persecuted by local villagers who hunt it for its meat with the aid of trained dogs. It is also subject to predation from leopards which still survive in the same hill regions and probably the fawns are occasionally taken by Jackals.

Captive specimens have lived up to 8 years (Dover, 1933) but their longevity in the wild is presumed to be five to six years.

#### Genus AXIS H. Smith, 1827

Antlers in male carried on short bony pedicles and having three tines only. Tail relatively long. No mane or crest on neck in males.

#### Key to the Pakistan Species of AXIS

Horns in male up to 53cm (measured straight). No upper canine teeth. Body fur coarse and not glossy and uniformly olive brown.

... *Axis porcinus*

#### AXIS PORCINUS

*Axis porcinus* Zimmermann, 1780; Hog Deer or Para (see Illustration 51).

**Description:** The Hog Deer is closely related to the Chital (*Axis axis*) which does not occur in Pakistan. It is a small deer with short delicate legs and a rather bulky heavy body. Its pelage is coarse and the general colouration is dark olive brown lacking any rufescent tinges when viewed from a distance. The guard hairs have white tips giving the coat a speckled appearance from close up. The naked rhinarium is brown, moist and rugose. The Hog Deer has noticeably large rounded ears which are fringed on the inside with white hairs. The short tail is quite bushy being covered with long hairs and these lie in a dorso-ventral axis so that the tail appears laterally compressed. Sometimes the tip of the tail has a few whitish hairs and there is also a limited area of brownish-white hairs around the inside of the thighs and the base of the tail.

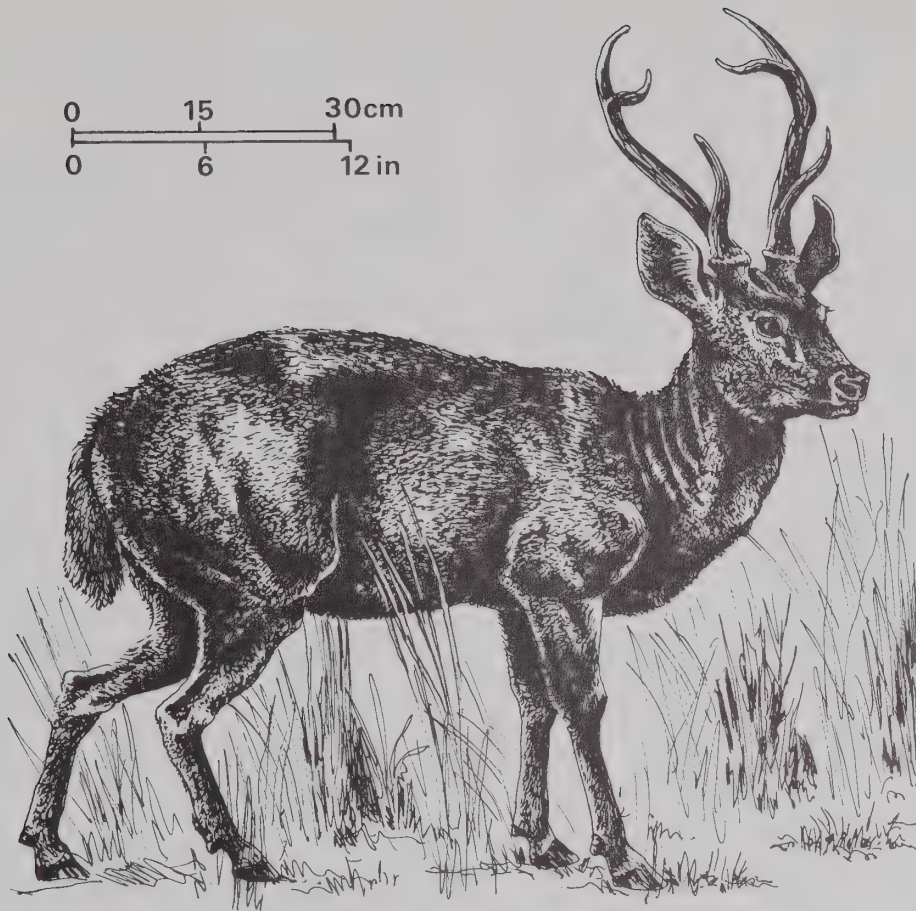


Illustration 51 *Axis porcinus*: Hog Deer or Para. (Based on captive specimen in Lahore Zoo, adult male descended from animals captured in East Nara, Sind.)

The hooves are small and neat with almost perpendicular pasterns in contrast with the Musk Deer which has sloping pasterns. Like the Muntjac, they appear to walk on the very tips of the toes.

Females are slightly smaller and lack horns. Adult males have noticeably thick muscular necks but there is no mane of longer hairs on the neck. The horns of the male are borne on fairly conspicuous hairy pedicles and they are relatively short and unimpressive, 30.5–35.5 cm (12–14 in.) being a typical length from the base to the tip measured in a straight line. There is one forward curving brow tine close to the base of the horn and a second much shorter tine near the tip of the main beam and usually pointed inwards. The main beam curves backwards and then forwards with the tips tending to come together. The surface of the horns are somewhat smooth with less corrugation than those of the European Red Deer or Sambar. A near record head was shot at Khairpur in northern Sind by Zulfiquar Ali Shah of Jamot, in about 1965. It had horns measuring 55 cm (21 $\frac{5}{8}$  in.) over the curve, 47 cm (18 $\frac{1}{2}$  in.) wide at their widest point and 38.4 cm (15 $\frac{1}{8}$  in.) wide at the tips. The brow tines were 22.2 cm (8 $\frac{3}{8}$  in.) long. There is a deep and conspicuous sub-orbital pit gland in the males of this species. The male develops small inconspicuous canines.

Young fawns are a paler sandy yellow colour and like most baby *Cervidae* very pretty to look at. They may show horizontal lines of paler creamy spots along their flanks but these spots are often very indistinct and disappear as they moult into their winter coat at about six months of age. Occasionally

adult animals in their summer coat will also show indistinct rows of spots all over the back and sides.

Adult males stand about 61–71 cm (24–28 in.) high at the shoulders. They measure 107–112 cm (42–44 in.) from nose tip to root of tail. The tail is about 18–20 cm (7–8 in.) long.

**Distribution and Status:** In Pakistan this Deer is confined to the riverain forest in the plains and particularly where there are extensive areas of dense grass thickets of *Saccharum spontaneum* and *Saccharum munja* and *Tamarix dioica*. With the increase of cultivation right up to the banks of the main river it is now confined to isolated pockets of jungle in the less accessible regions of the Indus. It is not found in the Himalayan foothill zone of Pakistan, which is the species' favoured habitat further to the east in India.

The bulk of the population now survives in the Indus river forest reserves of Sind, with small populations around the Indus Mouth, 12 miles north of Hyderabad in the Rajhari forest reserve, and the Kethi Shahu forest reserve 20 miles north of Sukkur. South of Hyderabad, riverain forests such as the Khirsar which used to contain a large population of Hog Deer, are now drying out due to control of the Indus river floods (Roberts, 1972) but some of the tamarisk studded islands in the Indus Mouth still contain Hog Deer. In the East Nara due to control of flooding and reduction of suitable habitat, the population is now reduced to one or two isolated pockets. In 1973 an estimated 20 or 30 still survived in the swamps around Sandori lake. They still survive in small





*Axis porcinus*

Distribution Map 67. Hog Deer or Para.

numbers along the Indus near Kandkot in Jacobabad district, and further north near Jamaldin Wali in Bahawalpur Division, also at Mohib Shah in Muzaffargarh district. A few survive at Tarinda Muhammad Panah, on the Chenab river about ten miles upstream from Panjnad. Up to the early 1960s a remnant survived in the forest plantation below Ghazi Ghat opposite to Dera Ghazi Khan. There are no other survivors in the riverain tracts of the Punjab except on the border with India e.g. around Suleimanki headworks on the Sutlej and Batapur on the Ravi river where there are still occasional reports of animals entering Pakistan territory. Two were shot by Mr. Krebb in the late 1960s. In 1972 six were killed in one beat (Major S. A. Khan, pers. comm.), in both instances near the Ravi at Batapur.

A few survived in Pirawala forest plantation near Khanewal up to the early 1950s though this is about 10 miles from the Ravi river. They were exterminated by local hunters. In Mianwali district between Darya Khan and Kundian they were considered plentiful 20 years ago and hunting them on horseback with greyhounds was regularly practised. They had apparently been completely exterminated from the district by the early 1970s (C. D. W. Savage, pers. comm.). Regrettably in the East Nara the population was decimated in the 1950s by hunters using jeeps at night equipped with spotlights (Karim Dad Junejo, pers. comm.).

The Hog Deer extends through the Himalayan foothill zone of India through Assam to Burma and Thailand but it is quite local in distribution and not found elsewhere in the Indian peninsula. They have been introduced into Ceylon.

Once plentiful throughout the riverain tracts of Sind and the Punjab, it now faces inevitable extinction within Pakistan territory unless special reserves are created for its preservation. Their considerable decline even within the past ten or fifteen years has been rapid and is due as much to a shrinking of their natural habitat as to hunting pressure.

**Biology:** The Hog Deer is not a social animal and lives a solitary existence, although in regions where they are plentiful it is possible to see several animals feeding in the same vicinity.

In feeding habits they are largely nocturnal, much more so than many other deer species, though they will emerge from cover to start foraging in the early evening in regions where they are not disturbed.

One of the principal foods of this deer in Pakistan is the young leaves of the Euphratic poplar (*Populus euphratica*) particularly the leaves of young saplings which sprout in huge numbers after the summer floods, on all the islands and sandbars in the bed of the Indus. They will also graze grass where this is accessible and show a preference for grazing rather than browsing. They are also very fond of the fruits of the ber tree (*Zizyphus jujuba*). They will not browse *Tamarisk dioica* though they are typically associated with this riverain tree.

Hog Deer can swim well and readily enter the water, so that they often take up temporary abode on islands between the channels of the Indus. When surprised or put to fright, they do not leap away with conspicuous bounds as do many deer and antelopes, but typically they run with neck outstretched and head held very low. This posture, together with their size and general colouration, has no doubt given rise to the name Hog Deer because of their superficial resemblance to fleeing wild boar which are encountered in the same habitat. When excited they erect their tails over their backs exposing prominently the creamy-white dorsal hairs. This no doubt serves as a contact signal for others of the same species.

In Pakistan, stags seem to shed their antlers from late January to early April. A stag shot in the East Nara in early February, seen by me, had newly-shed horn pedicles. New antlers are grown and in hard condition from early summer and the main rut lasts from August up to October. During this time the males are very aggressive and according to observations on the captive herd in Lahore Zoo they frequently challenge each other and fight by pushing with lowered heads and interlocked antlers. The males constantly seek out and pursue females at this time. The gestation period is believed to be rather lengthy, extending to eight months, and twins have often been recorded in both the Lahore and Karachi Zoo herds, though single young are more usual. The actual season of birth seems to be spread over a period from March to July with the majority of fawns being dropped in the spring and early summer months. A half-grown fawn observed at the end of February in the East Nara region was estimated to be about six months of age.

Newly-born fawns are dropped in some dense reed bed or thorn and grass thicket where they lie concealed for the first several days of their lives while the mother feeds in the vicinity and periodically returns for suckling. In the Himalayan foothills of Nepal new-born fawns have been observed in March and April. There is a very discerning account of a captive baby Hog Deer from Nepal including some observations on its behaviour when running free (T.A.K., 1923).

Zoo-kept specimens have lived up to 10 years of age (Dover, 1933) but nothing is known about their longevity in the wild. New-born fawns must be liable to predation from jackals and even half grown deer may occasionally fall victims to wolves but the chief predator on the Hog Deer is undoubtedly man.

#### Genus CERVUS Linnaeus, 1758

Males with antlers possessing four or more tines and with main beam bent backwards in an arc.

#### Key to the Pakistan Species of CERVUS

- (i) Adult males up to 135cm at shoulder. Both sexes

uniformly coloured yellowish-brown. Adult males with antlers 75cm long (around curve) with 5 to 7 tines in distal half of main beam projecting upwards and backwards.

... *Cervus duvauceli*

- (ii) Adult males up to 125cm at shoulder. Both sexes uniformly coloured greyish-brown. Adult males with antlers 100cm long (around curve) with an average of five tines, and the lower ones projecting forward from the main beam.

... *Cervus elaphus*

#### Subgenus RUCERVUS Hodgson, 1838

#### CERVUS DUVAUCELI

*Cervus duvauceli* Cuvier, 1823; Swamp Deer, Barasingha.

The Swamp Deer is much larger than the Hog Deer, with many-branched spreading antlers. It is now very rare in India and of particular zoological interest being an endemic species, confined to the subcontinent.

It used to occur in Sind in the riverain forests of the Indus and K. R. Eates recalls 'talking to grey bearded landowners in 1933 near the Duber and Sangi forests who remembered this Deer' (Eates, 1968). The Commissioner of Sind, H. E. M. James writing in 1893 refers to the 'goin' (Swamp Deer) occurring north of Rohri, as being almost extinct (James, 1893). Presumably it became extinct around the turn of the century, and Duber forest has long since been felled and brought under cultivation. It was called in Sindi, the 'chitto pharo' or 'goin' and evidently survived longer in the forests around Sukkur, as did the tiger, than further down towards the mouth of the Indus. (See Distribution Map 66.)

#### CERVUS ELAPHUS

*Cervus elaphus* Linnaeus, 1758; Red Deer.

Subspecies *Cervus elaphus hanglu* Wagner, 1944; Hangul, Kashmir Stag or Kashmir Barasingha.

This distinct subspecies of the European Red Deer is larger and greyer in pelage than the familiar deer of the Scottish highlands. It now survives outside of Pakistan and mainly in two or three herds on the northern side of the main Vale of Kashmir between the Liddar and Sind Valleys. Its status and prospects of survival are precarious as was shown in the recent survey by C. Holloway and G. Schaller (IUCN Tenth Congress, New Delhi, November, 1969). Fewer than 200 were estimated to occur in Dachigan Sanctuary, where most of these deer occur.

It does not occur permanently in Pakistan territory or Azad Kashmir though persistent reports come from Azad Kashmir claiming its existence in the forests of the Upper Neelum Valley, (e.g. Wild Life Enquiry Committee Report to the Government of Pakistan, 1969). In summer this Deer does make local migrations, travelling extensively over the higher mountain ridges and one specimen was actually shot in Pakistan territory not far from Burzil near the Kashmir ceasefire line in about 1955 (Brig. Aslam Khan, pers. comm., 1967). Ainsworth Harrison (pers. comm., 1965) investigated the northern forest regions of Azad Kashmir where the Hangul was stated to occur in the late 1950s and satisfied himself that there were none in the region at that time. However, unconfirmed reports (April, 1972) have come from the

Neelum Valley of Azad Kashmir that a small band of Hangul persists close to the Kashmir ceasefire line (Major S. A. Khan, in lit.). (See Distribution Map 66.)

#### FAMILY BOVIDAE

Some of man's most important domestic animals are derived from this family. It is represented by many diverse forms embracing 49 genera and about 155 species (Walker, et al., 1964). Most of the Bovidae occur in the old world and they generally inhabit natural grassland savannah country, though the wild sheep and goat representatives inhabit rocky and mountainous terrain.

The lower incisors are splayed outwards at a forward angle and there are no incisors or canine teeth in the upper jaw whilst the lower canine is modified to form the outer incisors (see Fig. 47). They all possess a gall bladder. Many species are gregarious, congregating in large herds, if not persecuted. Generally there is a scent gland between the hooves of these species which leaves a characteristic scent where the animal travels. This is a valuable factor in enabling isolated animals to rejoin the herd.

#### Key to the Family Bovidae

Possessing horns usually in both sexes which are permanent and consist of unbranched bone cores with sheaths of horn. No incisors or canines in upper jaw. Stomach with four compartments.

#### Genus BOSELAPHUS Blainville, 1816

#### Key to the Pakistan Species of BOSELAPHUS

Possessing sub-orbital pit glands, and a crest of longer hairs on top of neck. Males with small smooth cylindrical horns and blue-grey body colour. Females hornless and body reddish-tan coloured. Nostrils set in naked moist rhinarium. Shoulder height 120–140cms.

... *Boselaphus tragocamelus*

#### BOSELAPHUS TRAGOCAMELUS

*Boselaphus tragocamelus* Pallas, 1766; Nilgai or Blue Bull (see Illustration 52).

**Description:** The name 'nilgai', means blue cow in Urdu though the females are yellowish-brown and only the bulls are blue-grey.

The Nilgai has been assigned to a monotypic genus but is in most respects a typical antelope, and is considered quite closely related to the eland of Africa.

Reminding one as it does of a horselike cow this animal is often termed ungainly, but an adult bull is a handsome and impressive antelope. They are sturdy animals with stout legs and rather long sloping horselike necks, with, in both sexes, a coarse mane of long black hairs mixed with grey and white running down the hind neck and over the withers. The hair covering their bodies is short and wiry in both summer and winter coats. The whole head is long and narrow, almost horse-like and the nose black and naked. There is a small pit gland below the eye. The tail extends to just below the hocks and terminates in a tuft of coarse black hairs. Females bear no



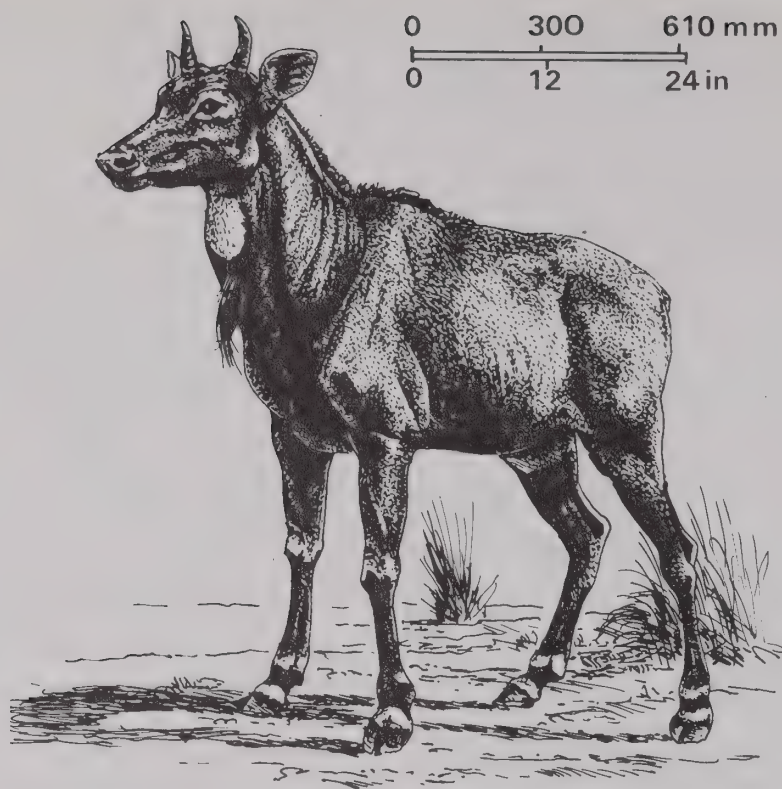


Illustration 52 *Boselaphus tragocamelus*: Nilgai or Blue Bull. (Based on captive specimen in Lahore Zoo, adult male descended from animals originally captured Changa Manga Forest Plantation, Punjab.)

horns and like the immature males, vary in colour from yellow brown to reddish-fawn with a conspicuous white throat patch under the angle of the jaw and several irregular white blotches on the lower part of the cheeks. The adult males are bigger than the females with noticeably higher sloping shoulders and very thick muscular necks. Their body, shoulders and flanks are grizzled a steely-grey with mixed white and black hairs whilst the forepart of the neck and lower chest, belly and inside of the legs is pure white. The backs of the ears are black tipped. The bulls have a similar white throat patch which is even more conspicuous than in the females. They also develop a peculiar long tuft of coarse black hairs hanging from the middle of the forepart of the neck. Generally there is some white about the muzzle and a conspicuous white patch inside the thighs and extending up to the root of the tail. The tail is also white on its ventral surface. Both sexes have conspicuous white stocking marks immediately above the fetlocks and also repeated round the pastern above the hooves. The horns of the male are cowlike in appearance, being black, conical and curving slightly backwards and outwards. The base of the horns tend to be slightly keeled in the front i.e. triangular in cross section. These horns despite the large size of the animal generally measure only 15.2–17.8cm (6–7in.) though 30cm (11 $\frac{3}{4}$ in.) is on record (Lydekker, 1907). An adult bull stands up to 1.5m (5ft) high at the shoulder with a head and body length of 2m (6 $\frac{1}{2}$ ft) and a tail length of 45–53cm (17 $\frac{5}{8}$ –20 $\frac{1}{8}$ in.). E. Walker (1964) gives adult weight at about 200kg (440lb) whilst A. Dunbar Brander (1931) gives the weight of a bull up to 270kg (600lb). Two adult females weighed 108kg (240lb) and 131kg (290lb) respectively (Crandall, 1964).

**Distribution and Status:** Tropical thorn forest and uncultivated semi-desert tracts preferably with some tree cover. Pakistan is somewhat too dry and treeless ever to have provided favourable habitat for this species.

There is practically no permanent resident population in Pakistan today, but Nilgai still regularly occur around the Indian border at Kasur in the north eastern corner of the Punjab and further south around Bahawalnagar, along the frontier with India. An entire herd consisting of seven animals, was shot one evening in 1967, near the border at Kasur (Anis Haider Shah, pers. comm.). Three were shot near the Ravi river at Batapur north east of Lahore by Mr. Krebb in 1968. Near Bahawalnagar, a large land owner at Munianwala claimed in 1968 to have two or three animals continuously on his land and to be preserving them (Muhammad Ashraf Hafeez, D. F. O. Cholistan, pers. comm.). In the winter of 1969 two Nilgai entered the Lal Sohanran forest plantation (east of Bahawalpur town), and though one was killed, the other was still living in the winter of 1972–73 in the forest. There must be many other records of animals killed recently in these regions which have not come to my notice.

Forty miles south of Lahore, is Changa Manga, the oldest irrigated forest plantation in Pakistan. Established in 1890, wild Nilgai from the surrounding areas quickly took advantage of the extra shelter provided by Changa Manga, and up to the late 1960s a small herd still managed to survive in the forest though they were regularly hunted by a privileged few (Z. B. Mirza, pers. comm., 1969). Up in Sialkot district there are occasional reports of stray animals crossing the border and in the first 10 years after Pakistan came into being Nilgai regularly occurred around Narowal and in the riverine thickets



Distribution Map 68 Nilgai or Blue Bull.

upstream of Marala Barrage (Colonel Dastagir, pers. comm., 1967). There are reports of a few Nilgai surviving in Azad Kashmir in the lower part of the Jhelum valley (Dr. Rahman A. Beg, pers. comm.).

In southern Sind, individuals also occasionally stray across the Indian border into the Thar desert and a young specimen captured alive in Tharparkar district in 1964 was shown to the Deputy Collector at that time (Dr. Imtiaz Ahmad, pers. comm.). Thus there is evidence that Nilgai could establish a foothold in both Bahawalnagar and Tharparkar regions if given total protection. In view of their propensity for raiding crops this is regrettably unlikely and the status of this fine antelope in Pakistan is thus the same sad tale of constant persecution and virtual extermination as with many other larger game animals.

There is evidence that at the turn of the century Nilgai were plentiful in Gujrat and Jhelum districts of the Punjab (Lydekker, 1907), but they must have been largely wiped out within the first two or three decades of this century as widespread land settlement and colonization programmes rapidly eliminated extensive areas of thorn forest which could provide them a safe refuge. It was apparently never able to colonize Sind successfully (Murray, 1884) and generally speaking the whole of Pakistan is too dry and too far to the west of the suitable habitat range for this species.

The Nilgai is endemic to the Indian subcontinent and widespread in all areas where there is not tropical forest or higher rainfall. It is absent from Assam, Eastern Bengal or Kerala but still occurs in Uttar Pradesh, Madhya Pradesh, Rajasthan, and Kathiawar as well as the Deccan. They are believed to be much reduced in numbers in all these regions despite being regarded as sacred by most of the Hindu farming population.

**Biology:** Nilgai are partly social in habits though they do not regularly congregate in large herds. Where they are plentiful in India they associate in small groups or bands. The bulls generally remain solitary. They feed mainly in the very early morning and late evening and generally rest under the

shade of some tree during the day. They graze grass as well as browsing on trees, particularly *Acacia arabica* and *Prosopis spicigera*. They are also fond of the fruit and leaves of *Zizyphus jujuba*. Dr. Schaller (1967) observed that they would even stand up on their hind legs to reach higher branches for browsing. They are reported to be fond of sugar-cane and will do considerable damage to this crop as well as maize if given a chance.

Breeding can probably occur throughout the year and this seems to be borne out by the small captive breeding herd at Lahore Zoo, though there appears to be a peak breeding season with more young being born at the beginning of the Monsoon season. Schaller (1967) observed that Nilgai bulls take up definite territories and form breeding herds during the rutting season, each herd consisting of one bull and two to ten cows. In India there seemed to be a peak rutting period during November and December in eastern Rajasthan. As already indicated, there is no permanent breeding population in Pakistan territory. M. W. Lacey (1969) records details of breeding Nilgaïs in captivity at Stanley Zoo in Northern Ireland. Oestrus was observed to last four days and occurred early in August, the gestation period being estimated at 247 days. Other authorities give the gestation period at eight to eight-and-a-quarter months (Crandall, 1964). Twins seem to be as frequent in occurrence as single offspring (Dover, 1933) and the young appear to be rather weak at birth in contrast to most antelopes, spending most of the first 10 days lying down and only standing up to suckle. Frequently the females become pregnant while still suckling and young of two different ages can be seen accompanying the mother (Dunbar Brander, 1931).

Adult bulls and even females have the habit of marking their territory by depositing dung at regular places. Schaller (1967) reports observing one bull during the rut, with nine cows and three calves in attendance, all of whom remained within a territory of about 200 acres during the 10 days that they were under observation. Within this territory he found five dung piles the largest of which was 91cm (3ft) in diameter and 10cm (4in.) high. The faeces consist of slightly elongated hard pellets about the size of marbles and are thus easily recognized (see Fig. 89).

In Pakistan, Nilgai probably have few natural enemies except man. New-born calves would, however, be susceptible to attacks from jackals and wolves. A hundred years ago Nilgai were frequently hunted by British sportsmen on horseback and armed with spears (Sterndale, 1884; Dunbar Brander, 1931). Despite their ungainly looking gallop Nilgai have great endurance and are fast runners so that this must have been a difficult sport requiring considerable skill. A captive specimen lived for 21 years but 12 to 15 years would seem to be about the maximum in the wild (Crandall, 1964).

#### SUBFAMILY ANTILOPINAE

Small to medium sized with slender legs and graceful build. Muzzle hairy up to edge of nostrils. Horns of males often heavily ringed or annulated. Females usually with shorter spike-like horns. Sub-orbital gland and inter digital glands present. Usually with hair tufts on knees.

**Genus ANTILOPE** Pallas, 1766

#### Key to the Pakistan Species of ANTILOPE

Medium size (70–80cm at shoulder). Pronounced sexual dimorphism. Adult males patterned black dorsally and white on throat and ventrum. Females hornless and reddish fawn



dorsally. Small hair tufts on knees (see Fig. 52). Males with long slender horns twisted spirally and bearing rounded transverse ridges throughout length except for extreme tip.

... *Antilope cervicapra*

ANTILOPE CERVICAPRA

*Antilope cervicapra* Linnaeus, 1758; Blackbuck (see Illustration 53).

**Description:** The Blackbuck belongs to a monotypic genus and is one of the subcontinent's better known animals. Uniquely indigenous to the plains of India, these beautiful antelopes which used to frequent relatively settled regions and open country, were especially familiar to early travellers.

The adult males are strikingly patterned in black and white, besides being of graceful build and bearing long spirally twisted horns. Sub-adult males and females are reddish-yellow in colour. Males do not assume a black coat until they are three years old and moreover this colour is not retained throughout the year being more intense at the end of the monsoon season when the animal has completed moult into a fresh coat. In mid winter the black colour begins to fade until the buck is quite brown by the beginning of the hot weather (early April). Even in winter however its brown coat is much darker than that of the females and young males. The hind neck even of mature males is rusty brown. It has been noted that adult male Blackbuck in south India never assume

this dark black pelage but remain brown. Both sexes have white bellies, lower chest, flanks and caudal area. The long narrow ears are thickly fringed with white hairs on the inside. The tail is relatively short and naked on its ventral surface. When excited the tail is carried curled over the back. Both sexes have a wide circular white patch around the eye, and this is particularly conspicuous in the mature bucks. Both sexes have white hair around the muzzle, which is hairy up to the nostrils unlike that of the Nilgai. Blackbuck females are normally hornless but an occasional individual will bear thin backward curving spikes and there was one such female in the small captive breeding herd at Bahawalpur Zoo, in the early 1970s. The horns of the males are marked throughout with prominent rings or ridges which are closer together towards their base. In addition to these annulations the entire horn curves through three or four complete spirals, and exceptionally even up to five spirals. An average horn length, measured straight is 50–61cm (19½–24in.). The record horn from a specimen killed near Delhi measured 71.5cm (28¼in.) in a straight line with a spread of 45cm (17¾in.) between the tips. This head is illustrated in Lydekker's *Game Animals of India* (1907) and has six complete turns in the spiral. Male Blackbuck have a particularly conspicuous sub-orbital pit gland. In both sexes there is generally a tuft of longer black hairs on the knee (metacarpal of fore-leg).

Adult bucks stand from 73.7–83.8cm (29–33in.) at the shoulder and have a head and body length of about 120cm (47in.) and tail length of 18cm (7in.). Twenty-one males shot by Col. Meinertzhagen in Rajhastan ranged in weight from

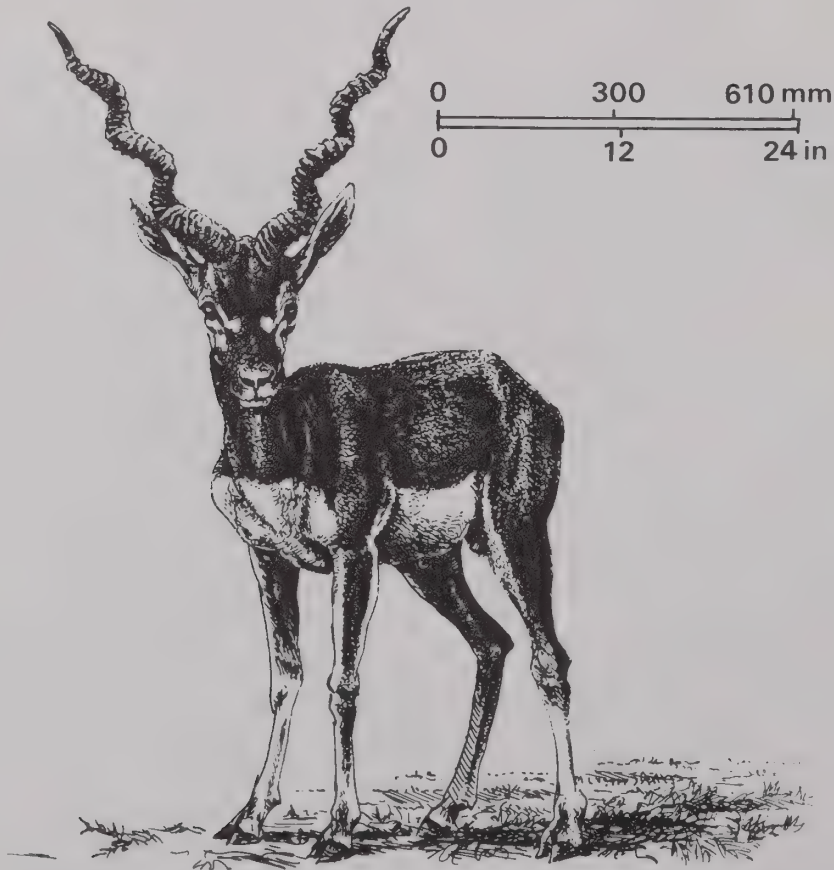


Illustration 53 *Antilope cervicapra*: Blackbuck. (Based on captive specimen Bahawalpur Zoo, adult male believed to be descended from animals originally captured Bahawalnagar, Bahawalpur Division.)

33.6–42.6kg (74–94lb) and two females 32kg and 38.6kg (71 and 85lb) respectively (Meinertzhagen, 1939).

Compared with the Chinkara Gazelle the Blackbuck is much sturdier and of heavier build. Its tail is not as long and is not covered with long hairs.

**Distribution and Status:** Blackbuck are primarily grazing animals and avoid forest areas but will survive in semidesert regions as long as there is sufficient scattered vegetation. Within Pakistan territory, there is no evidence that they ever extended west of the Indus, and they were most numerous in the semidesert tracts on the borders of Rajasthan (India). They are never found in mountainous country.

The main stronghold of the Blackbuck within Pakistan territory used to be around Bahawalnagar and Fort Abbas in the northern part of Cholistan. In the 1950s they were regularly seen and shot around Bahawalnagar. Even as recently as 1967 there was a group of twelve Blackbuck in Mogiwal Toba, a natural area of thorn forest (*Prosopis spicigera*) near Phulra close to the Indian border. They remained under

(H. H. Mir Ali Murad Talpur, Mir of Khairpur, pers. comm., 1973).

Blackbuck can therefore hardly be considered more than regular vagrants in the border areas with no permanent population and in this respect their status is very similar to that of the Nilgai. If they were given total protection they would probably succeed in establishing themselves.

There is increasing evidence that numbers in India have declined dramatically within the past 30 years. The Wildlife Preservation Society of India estimated that in 1947 the total population was 80,000 animals whereas by 1964 this had fallen to 8000 only (Seshadri, 1969).

Mention must be made of a project to reintroduce Blackbuck to Lal Sohanran Sanctuary. The Blackbuck were donated by Texas ranchers from a flourishing population earlier introduced into Texas, USA. This project under the auspices of the World Wildlife Fund aims at breeding these animals in captivity initially, until numbers build up sufficiently to allow release into the surrounding unfenced desert.

**Biology:** Blackbuck are gregarious and social animals and in the late nineteenth century, probably reached their greatest concentrations in the eastern part of the Punjab (India) where greater monsoon influence produced a savannah type vegetation most suited to this species. Dr. Jerdon cited a contemporary who informed him that herds calculated at between 8000 and 10,000 individuals had been observed in the Government Cattle Farm at Hissar (Jerdon, 1874). Increase in human population and disturbance has long since eliminated such huge herds and Blackbuck today could nowhere be encountered in herds of more than 20 to 30 individuals.

The Blackbuck is diurnal in feeding activity being able to tolerate the hottest rays of the sun. Generally they lie-up to rest in the shade of a tree for only two or three hours in the middle of the day. Dr. Schaller observed that wild Blackbuck in Central India very rarely browsed on any trees or bushes and almost exclusively grazed grass species where these were available (Schaller, 1967). In Cholistan District they have been observed to browse on *Acacia jacquemontii*. However studies of the Blackbuck introduced to Lal Sohanran reveal that they principally feed on grass species such as *Aristida mutabilis* and *Cenchrus pennisetiformis* and *Cymbopogon jwarancusa*. It has been reliably established that they do not drink water even when this is available, at many seasons of the year (Schaller, 1967). Earlier writers have also made the same observations (Blanford, 1888 and Lydekker, 1907). It may be, that they can recirculate the nitrogen in their bodies rather than having to excrete it in their urine (Schaller, loc. cit.). Blackbuck have been so much persecuted that they are now generally very shy and wary. They seem to rely largely upon eyesight in detecting danger and their sense of hearing and smell is not considered to be so highly developed (Prater, 1965). Their defence depends on fleetness of foot and there are surely few animals capable of greater speed and endurance. When initially disturbed Blackbuck very characteristically proceed by a series of spectacular leaps rising high in the air with each bound, and measurement of their tracks show that they cover 5.75–6.75m (19–22ft) between each stride (Dunbar Brander, 1931). The leaping of the Blackbuck when disturbed is very reminiscent of the action of Impala (*Aepyceros melampus*). After a while this bounding settles down to a steady gallop, which can be maintained without any diminution of speed for upwards of ten to fifteen miles. It has been claimed that Blackbuck have been timed to run at 95km/hr (60 mile/hr) (Seshadri, 1969), but this seems to be an exaggeration. In the Rann of Kutch they were observed to



*Antelope cervicapra* ■ Areas of recent regular sightings

Distribution Map 69 Blackbuck

observation for about two years but left the territory due to the prolonged drought. One or two Blackbuck were also seen to frequent Dodhlanwala Toba further south (Muhammad Ashraf Hafeez, D. F. O. Cholistan, pers. comm., 1968). Lieutenant General Marden (pers. comm.) recalls seeing many groups of 20 to 30 Blackbuck in the desert around Daharawar in the 1930s but these have long since been exterminated. Apart from these places in Cholistan near the Indian border, Blackbuck also occur on the edge of the Thar Desert near Nagarparkar though they have never been common in this area and no more than the occasional single individual has been sighted. The former Mir of Khairpur introduced Blackbuck in the early part of this century in the eastern desert portion of his State (northern Sind) where they were allowed to roam wild. In the 1950s Blackbuck were still numerous in this region (Eates, 1968). In the early 1940s it was still possible in this hunting reserve to see 30 to 40 animals in a day but now only about 13 specimens survive



be easily able to outstrip fleeing Wild Asses and to reach 40 mile/hr (Ali, 1946).

Blackbuck are relatively silent animals but females have been recorded as giving a warning of danger by a hissing noise which is akin to the noise made by *Gazella* species. Males during the rut frequently emit a throaty grunt.

The mature male Blackbuck tends to establish a territory during the rut and like the Nilgai they mark such territory by regularly depositing faeces in particular places. However they are not quite as consistent in this habit as Nilgai (Schaller, 1967). They are extremely aggressive during the rut, driving all other males from their territory. Many writers have described the appearance of the male during the rut (Lydekker, 1907 and Prater, 1965). It normally carries the tail curled over its back and steps with a rather high mincing gait. The nose and neck are stretched out and the horns carried horizontally over the back while the sub-orbital pit glands are everted. There seem to be two main breeding seasons with most rutting activity in February and March and a second peak at the end of the monsoon from mid August to mid October (Schaller, 1967). The gestation period is about six months and a single offspring is more common than twins (Crandall, 1964). In captivity Blackbuck have survived beyond 15 years, but the majority live about seven years (Dover, 1933).

Blackbuck are preyed upon by wolves and panthers in India. In Pakistan in the regions where they occur panthers are virtually unknown but newly born Blackbuck must be very susceptible to attack from jackals as well as wolves. At Lahore Zoo, newly purchased Blackbuck were placed in a high-walled enclosure adjacent to a pen in which

wolves were housed. During the first night after their arrival, one of the wolves howled, and the Blackbuck made strenuous attempts to jump up the high surrounding walls though they could not see the wolves. As a result one female injured herself fatally. Blackbuck have always had a propensity to raid crops, particularly sorghums and millets, and as they are not so well adapted to purely desert conditions as the Chinkara they have been hunted by man more intensely.

#### Genus GAZELLA Blainville, 1816

Within this genus, comprising the Gazelles, over fifty different forms have been described, and its taxonomy has been subject to much confusion in the past. Gazelles inhabit the desert and semidesert regions of Africa, the Middle East and Central Asia. They are all slender limbed small animals, adapted to subsist in arid conditions. Generally the females bear horns as well as the males. All have well developed pit glands in fore and hind feet, small sub-orbital glands and large pit glands in the inguinal region. Their hair is generally rather short and 'close pressed' without any trace of a darker dorsal streak. Often the face has a characteristic pattern of dark bands on the top and sides of the muzzle with paler creamy stripe between. Though there is still some disagreement amongst zoologists as to the named forms, generally about five exclusively African species are recognized and six more inhabiting the Middle East across to the Indo-Pakistan subcontinent. The Saiga (*Saiga tatarica*) and Tibetan Antelope (*Pantholops bodgsoni*) both belong to quite distinct and separate subfamilies.

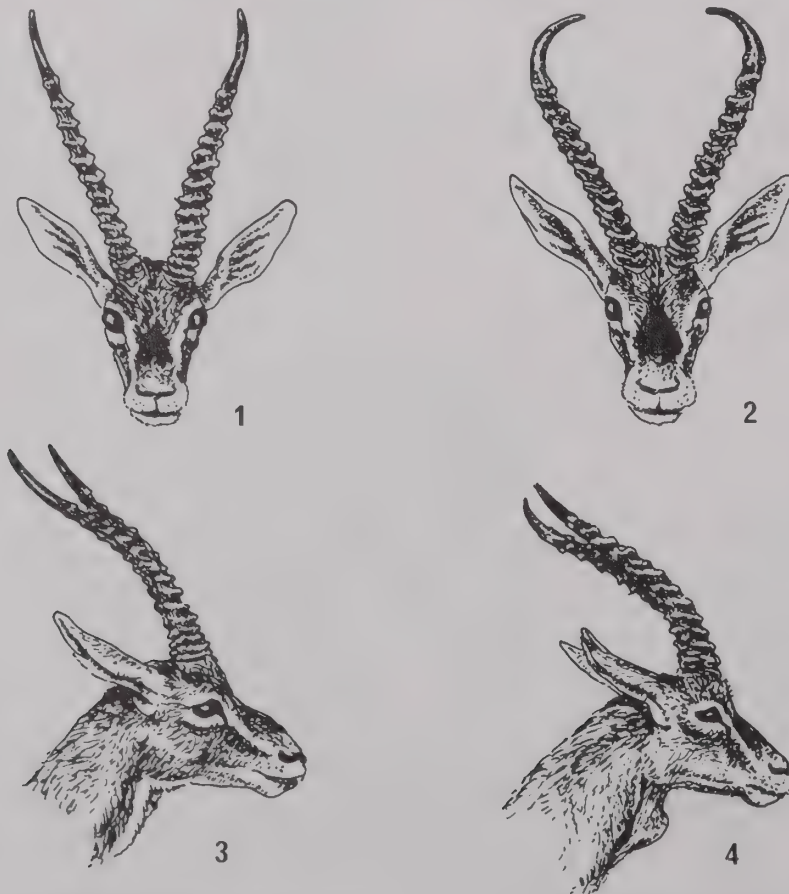


Fig. 51 Showing typical difference between heads of adult male Chinkara and Goitred Gazelle.  
1. Front view *Gazella gazella*.

2. Front view *Gazella subgutturosa*.  
3. Lateral view *Gazella gazella*.  
4. Lateral view *Gazella subgutturosa*.

**Key to the Genus GAZELLA Blainville, 1816**

Small size and extremely slender graceful build (50–60cm at shoulder). Tufts of hair on knees. Inguinal pit glands present. Males with black cylindrical slender horns, lyrate in outline and bearing prominent rings or ridged annulations. Females sometimes with horns.

**Key to the Pakistan Species of GAZELLA**

- (i) Females nearly always bearing horns comprising straight smooth spikes. Males without any enlargement of laryngeal region.  
... *Gazella gazella*
- (ii) Females without horns. Both sexes with visible swelling around larynx.  
... *Gazella subgutturosa*

**Subgenus TRACHELOCELE** Ellerman and Morrison-Scott, 1951

**GAZELLA SUBGUTTUROSA**

*Gazella subgutturosa* Güldenstaedt, 1780; Goitred Gazelle or Persian Gazelle.

**Description:** It is, in size and general appearance, almost indistinguishable from the much more familiar Indian or Arabian Gazelle (*G. gazella*). Males stand about 61cm (24in.) at the shoulder and females 56cm (22in.). The head and body length is about 100.7cm (3.5ft). Adult males weigh up to 23kg (50lb) and the females about 14kg (30lb). The ears are long and slender, measuring 14cm (5½in.) even in sub-adults. The inside of the ear is thickly fringed with white hairs. The tail which is longer than that of Wild Goat or Sheep species being about 12cm–18cm (4¾–7in.) in length, is covered with black hairs with a dorsal crest of longer hairs throughout its length.

The body is covered with long rather coarse reddish-grey hairs in winter coat having a blue-grey underwool and the belly and throat hairs are pure white and quite long and silky. In summer coat the fur is shorter and shows less admixture of white hairs being more reddish-buff, but it always appears longer and less glossy than the fur of the Indian Chinkara (*G. gazella*). The legs are very long and slender with dark brown tufts of hair on the knees (carpus) of the fore-legs. The hooves are black, sharp pointed and delicate in appearance and there is a small but conspicuous patch of black hairs extending up the pastern from the front of the hoof (see Fig. 52). The muzzle is well covered with whitish hairs up to the elongated nostrils. The eye is comparatively large with the whole iris almost black (in contrast to the wild sheep and goats). The face, has a distinct pattern with a dark chestnut-brown patch extending down the bridge of the nose with another narrower less distinct dark brown band extending from the corner of the eye to the corner of the mouth and both separated by a paler whitish band.

In summer coat there is an indistinct horizontal line of darker reddish-brown hairs separating the white belly fur from the flanks as well as a vertical darker stripe from the root of the tail and framing the narrow white caudal area. This is known as the pygial stripe and is much less conspicuous in winter coat. The pattern of the caudal region with the long black tail probably serves as an intraspecific contact or recognition signal when the animals are fleeing.

The males have cylindrical black horns with prominent

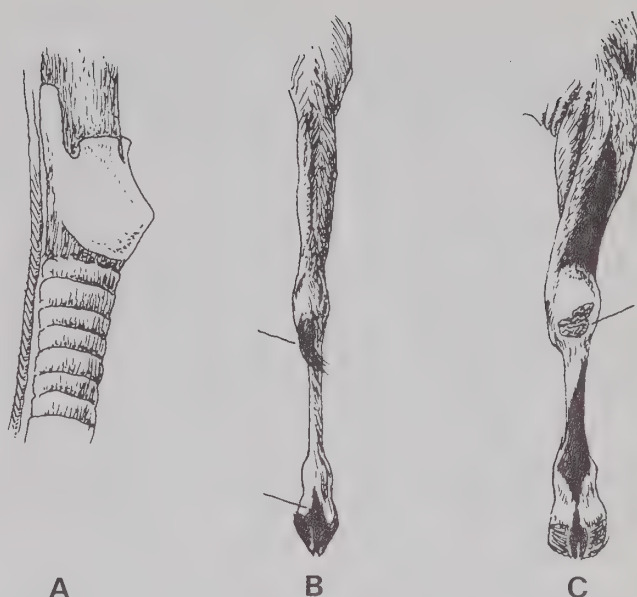


Fig. 52 Showing features of Gazelle species and comparison with wild goat.

- A. Appearance of trachea and enlarged larynx of 21 month old female, *Gazella subgutturosa*. Viewed from right side after dissection.
- B. Left fore-leg *Gazella subgutturosa* showing characteristic knee or carpal tuft and triangular shaped pattern of black hairs on pastern in front of pedal gland.
- C. Left fore-leg *Capra hircus*. Note large hooves and sturdy limbs in contrast to Gazelle species, also characteristic pattern of black and white hairs on front of shank with callous on knee.

rings or ridges. These ridges are close set in the proximal region gradually becoming less pronounced until the distal one fourth of the horn is smooth. The horns tend to be lyrate in outline when viewed from in front and from the side have a much more prominent 'S' bend than the horns of the Indian Gazelle (see Fig. 51). Sometimes the tips turn inwards though this is by no means a consistent feature. Horns vary from 21 to 31cm (8¼–12¼in.) in length (D. L. Harrison, 1968), whilst R. Lydekker (1907) refers to one pair which measured 40.7cm (16in.). Females are normally hornless though two tufts of longer hair are visible on the crown in adults. Females with rudimentary horns are occasionally recorded and the Street Expedition in Iran collected one such with 24mm long spikelets (Lay, 1967).

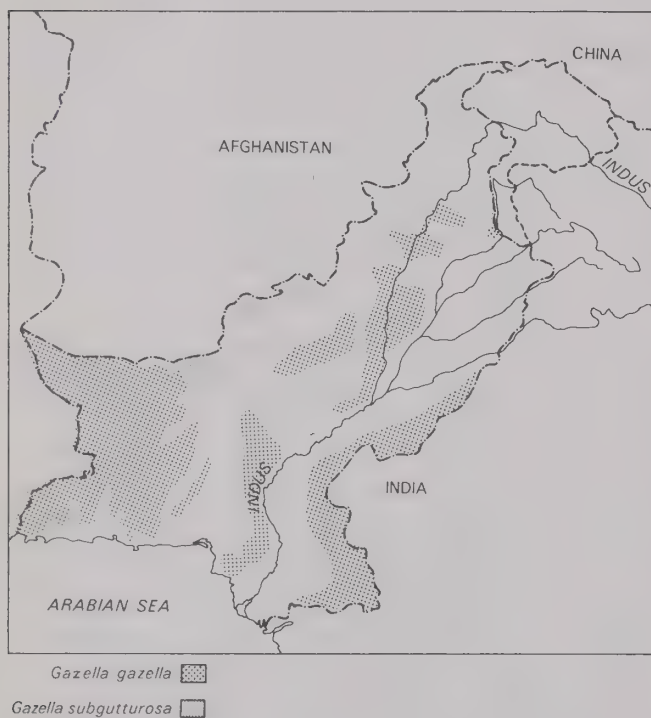
The most distinctive feature of this gazelle, which gives rise to its trivial name, besides its separation into the subgenus *Trachelocele*, lies in the development of a laryngeal or goitre-like swelling in the throat region. Lydekker (1907) refers to this swelling as being prominent only in the breeding season and indicates that it can be dilated. Subsequent authors have more or less repeated this statement, indicating that the goitre-like swelling is not conspicuous in the males outside of the breeding season and implying that females lack this feature (Harrison, 1968 and Walker et al., 1964). Captive male and female specimens reared by me both developed laryngeal swelling. In the male this was noticeable from about the age of 12 months and was considerably larger than that of the female. It was, if anything, more conspicuous in short summer pelage and outside of the rutting season and did not show any



visible sign of seasonal decrease or increase in size. The female did not develop the laryngeal swelling until about two years of age but it was thereafter easily and permanently discernible. Dissection of both sexes after death, showed that the larynx was sheathed in an enlarged cartilaginous cylinder (see Fig. 52).

**Distribution and Status:** In Pakistan it is found in the most desolate wide flat plains or plateaux between mountain ranges, generally at elevations from 1050m (3500ft) up to 2100m (7000ft). It may frequent regions of sand-dunes — or gravel plains or mud flats — all regions almost devoid of either water or vegetation, their only cover being provided by gullies or erosion ravines. They avoid steep rocky mountain sides as well as cultivated alluvial areas.

In parts of Arabia, the Goitred Gazelle occurs at sea level so that its occurrence in Baluchistan at higher elevations may not be ecologically significant.



Distribution Map 70 Indian Gazelle or Chinkara.  
Goitred or Persian Gazelle.

The Goitred Gazelle seems to be confined mainly to the border region of Baluchistan contiguous with Southern Afghanistan and the Seistan desert basin. They are found around Chagai and Nushki where their distribution apparently overlaps with the Indian or Arabian Gazelle (*G. gazella*) — further north they occur around the Chaman plain. A female specimen was captured from one of the higher valleys in Zarghun in 1973. They are much persecuted by local hunters and the population is believed to have been much reduced in recent decades.

In Iran they occur further south even to the province of Fars (Lay, 1967) and they extend westwards to the Arabian Peninsula, also into Afghanistan around Girishk (Hassinger, 1968) and the USSR in Trans-Caucasia and Russian Turkestan (Flint et al., 1965). Specimens from Arabia tend to have completely white faces (D. L. Harrison, 1968) but Baluchistan

specimens seen by me all had the characteristic dark chestnut nose patch.

**Biology:** The barren type of habitat frequented by Gazelles necessitates a fairly wide dispersion of the population and ranging by individuals over considerable distances in order to secure sufficient forage. They are therefore, never found in vast herds such as Blackbuck or some of the African antelopes. They do, however, exhibit some gregarious traits and usually associate in small parties of two to three individuals and occasionally even up to six or seven. Early travellers in Baluchistan at a time when the Gazelle population was considerably larger than it is today, also refer to seeing the Goitred Gazelle only in small parties of three to six (Sir O. B. St. John in Lydekker, 1907). They are normally active in feeding in the early hours of morning and again in the late afternoon, but where they are much persecuted they become partly nocturnal in feeding.

They appear capable of surviving not only on grazing from the few scattered tufts of grass and other forbes but also from browsing on various xerophytic bushes such as *Calligonum polygonoides* which grows in Baluchistan in shifting sand-dune regions. Apparently they are able to subsist for certain seasons without drinking any free water as none is available in most regions frequented by this gazelle. Captive specimens when provided with succulent fodder never showed any inclination to drink, but in early Autumn when fodder had a much lower moisture content they did drink occasionally. Observations of these same captive specimens in Khanewal showed that they lay down and chewed the cud through the hottest hours of the day, making no attempt at this time to seek shade as did wild sheep and goat species kept in the same conditions. This was observed on days when the shade temperature was 110°F (43°C), indicating that like camels they probably have developed some degree of thermal inertia being able to increase their day time body temperature without upsetting normal metabolic processes and being able to withstand hypothermia. It is believed that they can dissipate this same stored heat, during the relatively cooler night (Schmidt-Nielson, 1964).

The Goitred Gazelle has the habit shared by the Chinkara (*G. gazella*) of depositing its faeces (see Fig. 85) in regular places, and females will also follow the same habit, but they do not stick to any well-defined territory outside of the rutting season and the habit is perhaps less well marked than in such species as the Nilgai.

Observations of captive specimens in Khanewal (kept more or less in the same latitude and climatic conditions as the wild population) showed that there is marked periodicity of the rut in males which regularly occurs from the second week of December till early January. An oestrus female Chinkara introduced repeatedly to a male Goitred Gazelle in February and again in March did not elicit any sexual interest. It was however successfully mated the following autumn and the resultant hybrid, a male, showed slight traces of a throat swelling when seen by me two years later. During the rut period the male is highly excited — often trotting up and down with tail raised and sub-orbital pit glands everted. They frequently call with a very guttural grunt and are extremely aggressive. Captive specimens will not hesitate to attack humans and even female gazelles if the latter are not able to escape from them. There seems no basis, according to my observations of comparative behaviour, for the statement that Gazelles are less aggressive than Blackbuck during the rut (Prater, 1965). If anything, they tend to be more aggressive than wild sheep or goat species. A 19 months old male Goitred Gazelle exhibited rut behaviour and appeared to be sexually mature. In this

respect they are earlier maturing than the *Ovidae* or *Caprinae*. The female appears to be sexually mature also at the same age — just under two years.

Males fight during the rut by rushing at each other and pushing with interlocked horns. At this time the head is held very low often with the muzzle almost touching the ground. The tail is raised vertically and often wagged rapidly whenever the animal is excited. The female comes into oestrus for a very short period — often only about 12 hours during which a slight swelling of the vulva is noticeable. The act of copulation itself only lasts about three seconds so that breeding is difficult to observe even with captive animals. The gestation period for closely related African species of Gazelles has been recorded in captivity as varying from 169 to 179 days (Dittrich, 1968). Until more information is available it must be assumed that the gestation period in the Goitred Gazelle is much shorter since the rut lasts during the month of December and in Baluchistan young are mostly born from late April up to early June. A captive gazelle in the author's possession was actually mated on 1 January and produced a single fawn on 5 June after an estimated 156 days gestation period. Five to five and a half months would therefore seem to be the gestation period. *G. subgutturosa* was successfully bred at the London Zoo for a number of years, during which it was found that out of 23 births recorded May was the peak month for parturition with only 2 births later in the summer outside of late April to early June period (Zuckerman, 1953). It was also found that about one third of the births which occurred were of twins. One earlier observer working with the Baluchistan-Afghan boundary commission, claimed that the Goitred Gazelle produced its young in late January and early February as five females shot in Seistan between 13 December and 16 January carried foetuses. These observations besides being at variance with the known season in which baby Goitred Gazelles can be captured in Baluchistan, may well be the result of confusion between *G. gazella* and *G. subgutturosa* both of which species do occur in Seistan (Cumming, 1905). The Street expedition in Iran collected three female Goitred Gazelles from 10 November to 10 January, none of which was pregnant or lactating (Lay, 1967).

A captive born Goitred Gazelle continued to suckle for about five months but showed interest in green fodder from about one month of age. It was noticed that when suckling it often rapidly swung one of its fore-legs to and fro in a pendulum motion, particularly when suckling vigorously.

The hearing, eyesight and sense of smell of these animals all seem well developed. Their only vocalization besides the grunt of the rutting male, despite the hypertrophy of the larynx, is a sibilant hiss which is an alarm note, generally made by the females as a warning signal before taking to flight. It is not such a loud or explosive noise as the warning snort of sheep and goats but is produced in the same way by expressing air through the nostrils. Observation of captive gazelles shows that they are highly nervous and excitable in disposition, with a lower flight threshold than the wild sheep or goats. When excited or disturbed they have a characteristic gait which consists of a series of stiff-legged short bounds or jumps. This has been aptly described as stotting and is rather pretty to watch.

Young gazelles which do not follow their mothers for the first two or three days after birth must be liable often to predation from Wolves and Hyenas, both of which frequent these barren Baluchistan plains. The local hill people also hunt them on camelback, often using ancient muzzle-loading firearms which are family heirlooms. The record for longevity in captivity is 14 years 9 months (Crandall, 1964).

## GAZELLA GAZELLA

*Gazella gazella* Pallas, 1766; Common or Indian Gazelle (see Illustration 54).

Subspecies *Gazella gazella bennetti* Sykes, 1831; Chinkara or Ravine Deer.

**Description:** The detailed description of size, weight and other external features given for the Goitred Gazelles, do not differ in this species. The principal differences relate only to the absence of any enlargement or swelling in the larynx, differences in the pelage, and the development of the horns.

In summer coat, the Indian Gazelle is of warm biscuit, or reddish-buff colour, with the fur smooth and highly glossy. This is probably a valuable adaptation for reflecting back some of the sun's rays and thus minimizing heat absorption during the very high day time temperatures experienced in its habitat. Even in winter coat the white belly and throat fur is smooth and short in contrast to that of the Goitred Gazelle, and the upper part of the body is more reddish-yellow and shorter furred. Like the Goitred Gazelle the tail is medium-long and covered with a dorsal crest of black hairs. There are indistinct horizontal and pygeal stripes bordering the flanks and caudal areas in summer coat.

The females normally develop quite long horns in contrast to the females of the Goitred Gazelle. Usually these consist of relatively straight smooth thin spikes curving backwards without any annulations. But in some females annulations or ridges are visible in the proximal portion of the horn (Dunbar Brander, 1931). Such horns average 75–100mm (3–4in.) in length but a female with 23cm (9in.) long horns was killed in Campbellpur district (Lydekker, 1907). The populations of this gazelle inhabiting the western borders of Baluchistan, especially in the Mekran, however, has females which are often hornless.

Males have horns similar in size and general shape to the Goitred Gazelle but they tend to be less lyrate and to be almost straight when viewed from in front. Also they never curve inwards at the tips as do those of some Goitred Gazelles (see Fig. 51). The average horn length of males is 25.5–30.5cm (10–12in.) measured over the curve, with record horns reaching just over 39cm (15½in.). A head of 40cm (just under 16in.) was shot in the Kala Chitta hills in the late 1940s (Ainsworth Harrison, pers. comm.).

**Distribution:** A very adaptable animal, it seems to be able to exist in extensive sand-dune areas down to sea level as well as in stony plateaus and low hilly regions up to 1500m (5000ft) elevation. They can retreat for shelter during the day into quite steep mountain ravines or gullies as observed in the Kirthar and Margalla Hills but generally they avoid steep hill-sides. They are not found in the alluvial plains in regions of extensive cultivation which habitat is favoured by the Black-buck in regions of India. (See Distribution Map 70.)

The Chinkara is severely reduced in numbers, perhaps to the point of extinction, in the desert regions all along the eastern border of Pakistan. It is not however, in danger of extinction in the country as a whole, because it is so widespread and also lives in rocky escarpment areas where motorized hunting is impossible because of the terrain.

Once plentiful in Dera Ghazi Khan, and Dera Ismail Khan districts and the Thal desert, they are all but exterminated from these regions. However parts of the Salt Range around Kalabagh as well as the Kala Chitta Hills still contain very good populations of Chinkara and the broken nature of the ground with steep erosion gullies affords them adequate cover.



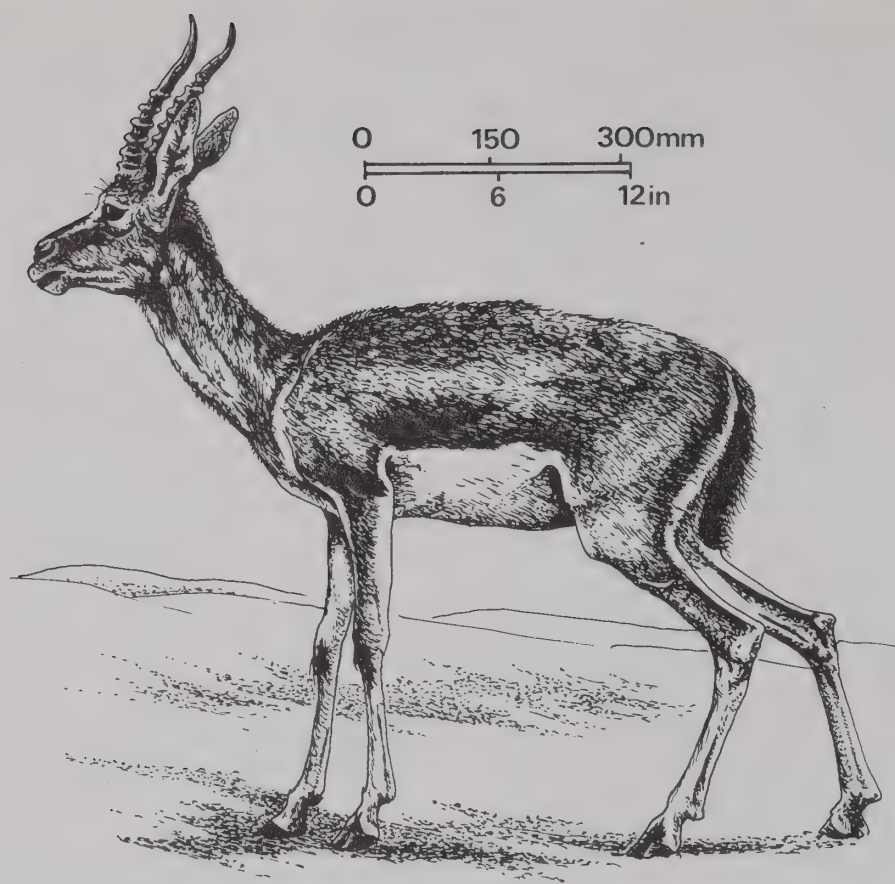


Illustration 54 *Gazella gazella*: Chinkara or Indian Gazelle.  
(Based on live captive specimen, 2½ year old male from  
near Rahim Yar Khan, Bahawalpur Division.)

A few still survive in the Potwar region of Rawalpindi, finding refuge in the ravines of the Margalla Hills, though their numbers are believed to be very very small. An individual was sighted in January 1972 behind Islamabad (Mrs. V. Wheeler, pers. comm.). Once plentiful in the North West Frontier Province around the plains of Mardan and Peshawar and still occurring in the 1940s, it has apparently been exterminated from these regions. In the north western region of Baluchistan there are still Chinkara in the wide stony valley behind Hindu Bagh and northwards to the Zhob valley. Females from this region bear horns (Stockley, 1930). They occur further south in the Sibi plains as well as south west Mekran, especially around Turbat and south east of Panjgur where they still survive in good numbers (Mumtaz Ali Khan, Locust Control Officer, pers. comm.). They are still widespread in Las Belas and a few survive in the ravines at the base of the Kirthar range in Sind and around Dadu district in the Lakhi Hills. In the Indus alluvial plain, a few survived in barren uncultivated areas such as Shorkot Road and Chak Shahana in the south west Punjab up to the 1940s. Regular hunting in these areas has now led to their extermination. A fair number of Chinkara survive in the Takkar Reserve to the immediate east of Khairpur in Sind but the presence of troops in the border regions of the Thar desert as well as Bahawalpur have led to the virtual extermination of the once plentiful gazelle population over this vast area. The Conservator of Forests, Bahawalpur, enforced a total ban on the hunting of this species in Cholistan region in 1969–70 and after one year, a census of the whole region revealed an estimated population of under 800 within a territory which must have included at least 5000 Chinkara

in the early 1950s (W. A. Kermani, Chief Conservator, pers. comm., 1970). There are many accounts of senseless slaughter of this graceful little animal even in the past several years. A motorized hunting party in Tharparkar was reported in about 1970 to have killed 26 in a two day shoot (Karim Dad Junejo, pers. comm.). If permanent protection was afforded to them in Cholistan or Tharparkar they could rapidly recover in numbers since twins are frequently produced and some females seem capable of breeding when under one year of age, (Crandall, 1964).

According to Ellerman and Morrison-Scott (1951) *Gazella gazella* extends from Morocco, Algeria and Western Tunisia through the Arabian peninsula. In North Africa it is called the Mountain Gazelle. The Arabian population has however been assigned to a separate species by some authorities (Groves and Morrison, 1967).

**Biology:** In its wide roaming habits, tendency to keep to small groups of 2 to 3 individuals and its general alertness, the Chinkara is very similar to the Goitred Gazelle. In 1969 in early November, I observed a herd of eight Chinkara on the Jabbah plateau in the Salt Range (Mianwali District). One old and experienced professional tracker and hunter in Cholistan stated that even when Chinkara were plentiful 30 years ago, he never saw a herd of more than seven or eight individuals and that two to three is more usual. (Mohammed Hayat, pers. comm.). There is sufficient evidence that compared with the Goitred Gazelle, the Chinkara is more nocturnal, though they will emerge to forage before sunset. One cultivator near Fort Abbas, while going to put fodder before his cattle at

about 10 pm, surprised a Chinkara actually feeding from the cattle trough (W. A. Kermani, Chief Conservator of Forests, pers. comm.) and they certainly raid crops on the border of Cholistan, after darkness, retreating by day up to eight or ten miles inside the desert. They are better adapted to browsing than the Blackbuck and not so dependent upon grasses. In Cholistan during the early part of the summer they have been observed to browse on various bushes including *Leptadenia spartium* and *Acacia jacquemontii*. If nothing else is available, they will also browse the green twigs of the much commoner *Calligonum polygonoides*. During the monsoon season and early winter they mostly subsist on grazing and preferred grass species in Cholistan region appear to be *Aristida mutabilis* and *Aristida funiculata*, with *Cenchrus pennisetiformis* in the early monsoon season when it produces young growth. Normally they can get all the moisture they need from such green herbage, especially in winter when there is dew at night. But they will seek water in the hotter summer months and even throughout the year if it is accessible. I have seen a buck drinking at sunset in late March in the Kala Chitta hills and fresh tracks in December in Cholistan around a water channel near Rahim Yar Khan which indicated that the Chinkara had almost certainly been drinking. Probably they can go for many days without drinking and in the early summer there is evidence that they eat the fruit of the wild pumpkin (*Citrus colocynthis*) which grows on sand-dunes and contains about 90 per cent water. Also in February I have seen signs that they dig up and eat the succulent stems of the parasitic plant *Cystanthe tubulosa* which is also a valuable source of water. They show a fondness for feeding in cultivated crops of rape-seed (*Brassica* spp.) and sorghum (jowar) when these are grown in desert border regions.

Chinkara have a habit similar to that of *G. subgutturosa* of depositing their faeces in regular places, and there is some evidence for believing that during the rutting season males will frequent particular territories (Mohammed Hayat, pers. comm.). S. H. Prater (1965) states that the Chinkara in India has no particular breeding season. In Pakistan the rut appears to occur in two seasons, one lasting from the end of the monsoon up to early October and again in the late Spring from March to the end of April. A small captive breeding herd at Khanewal Cooperative Textile Mills also showed two similar peak breeding seasons. The males are very aggressive during this period and two males will at once fight if they encounter each other, often becoming oblivious of danger in the process. It was claimed by one old shepherd that on one occasion when two males were fighting he had been able to creep up and seize one of the combatants by the hind leg (Mohammed Hayat, pers. comm.).

The grunting of rutting males, and raising of the tail when excited as well as the hissing alarm snort, have all been observed in this species, being in no way different from the Goitred Gazelle. The gestation period appears to be about five to five and a half months and twins have been noted quite frequently (Dunbar Brander, 1931). Even triplets have been recorded from a captive female (Crandall, 1946).

Newly born Chinkara gazelle have often been encountered by sportsmen in the early days when they were more plentiful in the region. They characteristically lie often in barren exposed places and with head and neck extended along the ground making no attempt to get up and escape from humans. They are thus often captured and sold as pets by local nomadic tribes from the desert regions and Lahore Zoo is generally presented each year with two or three such animals after they get a bit older and difficult to keep. The young do not follow their mothers until they are two or three days old

and therefore they can easily become fixed on to a human foster-mother if captured at this age — following their human owner like the pet lamb of the familiar nursery rhyme.

A captive female of the Arabian subspecies gave birth to its first young when only 12 months old (Crandall, op. cit.). However a captive Chinkara in my possession, did not appear to become sexually mature until two years of age. It was kept in an adjacent pen to an adult male. It came into first oestrus on 15 February and again on 10 March, indicating roughly a 28 day cycle.

Nothing is known about their longevity in the wild. The young must be susceptible to predation from jackals and wolves and possibly Caracal Cats. The adults probably have no serious enemies except man. In the Cholistan and Thar desert regions they have been hunted in the past 20 years almost to the point of extermination by jeep-mounted hunting parties.

#### SUBFAMILY CAPRINAE

Stockily built ruminants which are generally adapted to climbing in mountainous terrain. Both sexes with horns. Facial (sub-orbital) glands absent or vestigial. Pit glands in fore-feet and sometimes in hind feet.

#### Genus NAEMORHEDUS H. Smith, 1827

The genus contains two species, the Himalayan and Burmese Goral.

#### Key to the Pakistan Species of NAEMORHEDUS

Small size -- (60–70cm shoulder height). Ears broad and bell-shaped. Both sexes with horns of almost equal size which are slender, cylindrical, not divergent but backward curving and bearing inconspicuous annulations or ridges. No beard in males. Small sub-orbital pit glands. Females with four mammae.

... *Naemorhedus goral*

#### NAEMORHEDUS GORAL

*Naemorhedus goral* Hardwicke, 1825 (see Illustration 55).  
Subspecies *Naemorhedus goral goral*; Grey Goral.

**Description:** This shy little animal is not very well known as its small horns do not attract the trophy hunter, nor zoological exhibitors.

It is the size of a small goat, adults standing 65–71cm (25½–28in.) high at the shoulder with a head and body length of 105cm (41½in.) and weight from 25–28kg (56–63lb) (Lydekker, 1907 and Primrose, 1911). It is quite an attractive animal with its large bell-shaped ears and deer-like face. The ears are thickly fringed inside with white hairs, the eye is large with a dark iris and males do have a poorly-developed sub-orbital gland, contrary to what is repeated by many authors (Prater, 1965 and Walker et al., 1964). The profile of the head is somewhat convex and the rhinarium is moist with a naked area around the nostrils more akin to the Cervidae than the true goats.

General body colouration is dark greyish-blue, and when seen close up the hairs are banded with black and buff giving the pelage a speckled or pepper and salt appearance. Older bucks tend to be a darker steely-grey and also develop, in winter coat, a rough crest of longer black and grey hairs down the back of the neck and over the shoulders. The tail is longer





Fig. 53 Showing distinction between heads of adult Himalayan Grey Goral. Note male on left with horns slightly more divergent and much thicker basally. Female on right with horns less divergent and more slender.

than that of wild goat species, barely extending below the level of the belly and being covered with a mixture of long black and grey hairs. The legs are sturdy and goatlike in appearance with broad hooves and the hind legs appear longer than the fore-legs, with the spine arched and rump higher than the shoulders. There is an indistinct black mark in the front of the fore-legs. The chest and belly are paler grey and there is a conspicuous white patch in the upper throat with one or two white spots on the lower muzzle and cheeks. In summer coat the hair is smooth and short.

A 30 months old male from Swat had ears measuring about 15cm (6in.), with the tail about 15cm (6in.) long. Its horns measured only 5cm (2in.). It had, in summer coat, no trace of a crest on the hind neck but a black line of hairs down the back of the neck and also a darker grey line extending along the spine.

In both males and females the horns are slender, black, conical and curving backwards at the tips. They are very sharp pointed and bear small closely-spaced annulations or ridges in their proximal region. Females have horns almost as long but more slender at their base and slightly less divergent when viewed from in front (see Fig. 53). A mature animal of either sex will have horns up to 12.5–15.5cm (5–6in.) but 23.5cm (9¼in.) is on record (Stockley, 1928).

Both sexes have pit glands in the pastern of the fore and hind feet and as mentioned above the female has four mammae.

**Distribution and Status:** In Pakistan it occurs only in the outer Himalayan foothills in association with scattered chir pine (*Pinus roxburghii*) and thorny clumps of barberry (*Berberis ceratophylla*). In the Murree foothills and Margalla range they occur from about 820m (2700ft) up to 1500m (5000ft) and in Swat up to 1950m (6500ft). These are regions below the Blue Pine zone and characteristically it frequents regions of precipitous cliffs with a fairly dense cover of thorny bushes and it is not found on the more open gentle mountain slopes.

The Goral is found in certain mountain ranges in lower Swat, as well as the Indus Kohistan, the Boga Marg Valley in Hazara district, parts of the Neelum Valley in Azad Kashmir

beyond Ath Muqam (Major S. A. Khan, in. lit., 1972) and the Margalla hills. A fresh killed head was seen in 1968 from Shahid Pani in the Siran Valley (T. H. Braham, pers. comm.). In Swat they occur in the hills behind Murghazar and again near Karrarker but they are now excessively rare in these regions due to constant persecution by hunters (Z. B. Mirza, in. lit., 1971). They have also been encountered in the Bunir district of Swat around Dandikot and Khujoorag in the late 1960s (R. F. Nana, in. lit.). They occur around Shahid Pani in the lower Kaghan Valley. They are known in Dir but I have no definite records as to its distribution in that State and it appears that they never spread westwards into Chitral nor northwards in Gilgit. In the North West Frontier Province they also occur in Malakand tribal territory in the Kanori Hills



Naemorhedus goral Known distribution Probable range

Distribution Map 71 Grey Goral.

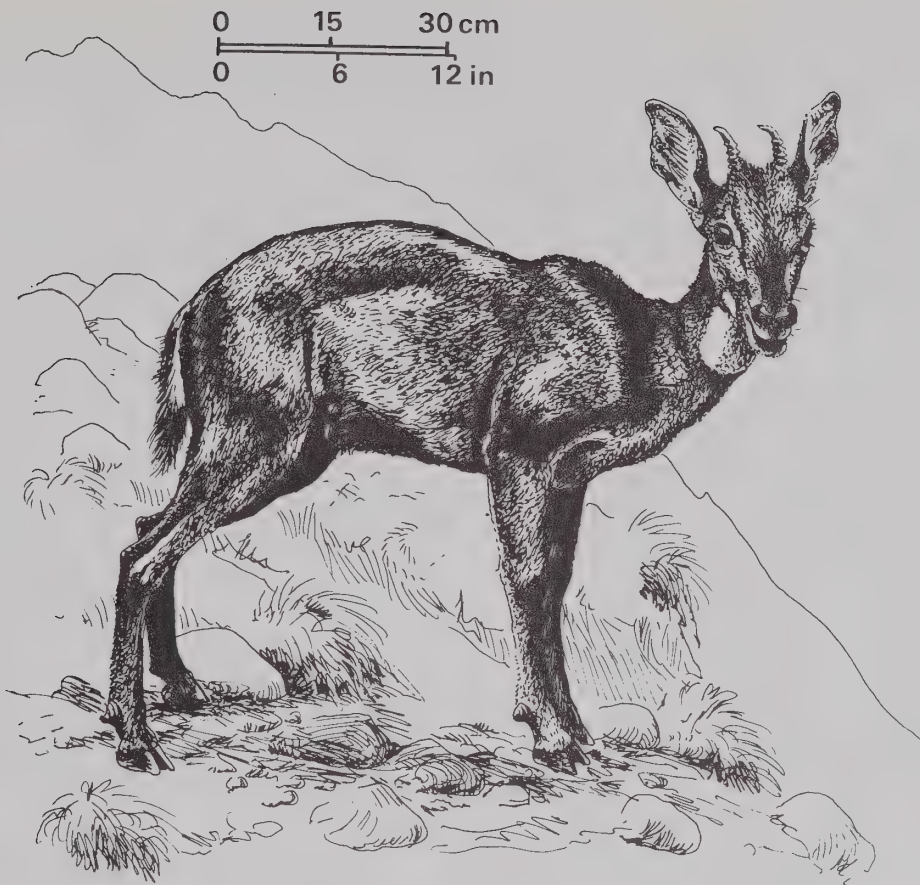


Illustration 55 *Naemorbedus goral*: Grey Goral. (Based on captive specimen 2½ year old male in summer coat from Murgharzarine Hills, Swat.)

and possibly still in the Cherat Hills behind Nowshera (Ikramullah Khan, landlord, in. lit.). The main surviving population in Pakistan is now to be found in the Indus Kohistan region between Swat and the Kunhar Valley catchment.

A few survive in the Margalla hills though the total population may be less than 15 or 20 individuals (Ainsworth Harrison, pers. comm., 1971). One was seen in 1971 as far south as the ridge behind Islamabad. They do not apparently occur further east in the hills around Lehrar or Kahuta.

Goral occur practically in the same habitat as Markhor in Malakand and Southern Swat and in the Margalla hills their habitat overlaps with that of the Barking Deer.

Outside of Pakistan, the Goral extends right across the Himalayas to the Mishmi hills in Assam and even down through the hill ranges of southern Burma. It extends into south eastern Siberia and up to Korea and through the mountainous regions of China. Swat is about the western extremity of its range.

Unless Goral are totally protected, especially in Southern Swat region, they are not likely to survive another decade in Pakistan. Despite having a wider distribution than the Barking Deer, they are much rarer than the latter in the Margalla hills.

**Biology:** Goral are not particularly sociable though in areas where they are not disturbed two or three will often be encountered feeding in the same proximity. Adult males are usually encountered singly. They generally feed in the later afternoon and again in the early morning and it has been observed that they seem deliberately to choose shadier hill slopes for feeding, avoiding bright sunlight. Thus in the early

morning they are more likely to be encountered on north westerly facing slopes and in the evening on north easterly slopes (Burrard, 1926). In the Margalla hills due to frequent human disturbance, they are however more nocturnal in habits, and a local hunter has encountered Goral actively foraging two hours after darkness in the hills behind Nurpur Shahan (Ainsworth Harrison, pers. comm.).

Goral principally subsist on grazing the tussocks of grass which grow in scattered clumps in these regions. The most common grass species in this zone is *Aristida cyanantha* and this is eaten by all domestic stock in the winter and early spring. During the monsoon season it grows tall and coarse and probably at this time the Goral favour the other two grass species *Apluda aristata* and *Themeda anathera* which are widespread in these outer foothills at such elevations. During the day Goral conceal themselves very cleverly, often under some overhanging rock or inside a cave if possible. They make full use of bushes and grass clumps if these provide cover in front of some rock crevice or hollow, and they rely upon remaining undetected even when such regions are in close proximity to human disturbance from fuelwood and fodder collectors. They are true ruminants with four stomach chambers and chew the cud during the day time.

If approached during the day time while they are resting, Goral do not move or take fright until the intruder is right upon them, relying heavily upon their natural concealment. But if put to flight they bound away often up hill, with great leaps, in an irregular zig-zag manner, usually contriving to put some ridge or cover between themselves and their pursuer as quickly as possible and often retreating into a fresh hiding



place before having travelled very far. In these habits they are very different from most other mountain game when disturbed. They are very sure footed and traverse steep rock faces with almost the same agility as the true goats.

In Pakistan the rut appears to be at the end of the monsoon season and early in winter. At this time the males are said to possess a strong goaty odour. The gestation period has been variously stated as six months (Walker et al., 1964 and Lydekker, 1907), up to eight months (Prater, 1965). Captive Grey Gorals at the Prague Zoo appeared to have a gestation period of 240 days, and the females did not reach sexual maturity until two years of age (Dobrorouka, 1968). Despite the female having four mammae, twins seemed rare and single offspring more usual with this captive breeding herd.

Prater (1965) states that the young are born in May and June but according to available evidence the western Himalayan population seems to breed earlier than the Goral in the eastern part of the Himalayas. In Swat, a female Goral shot on 17 April in Bunir district contained almost a full term foetus which was well covered with fur (R. F. Nana, pers. comm.). A very young Goral kid was killed by a local police officer in the same region in late April also (R. F. Nana, pers. comm. and in lit.). Another observer in the Garhwal hills saw a new-born Goral on 20 April (Searight, 1926). Local hunters also state that Goral are born during April and May in the Margalla hills. The young remain with their mother until the next offspring is born. Females with young kids tend to keep away from other small groups.

Goral are preyed upon by Panthers and also possibly, by Wolves, but man is a far more serious predator as far as the Pakistan population is concerned. Living as they do in lower accessible hills, the local villagers find them a relatively easy quarry, despite the steep and difficult nature of the terrain they frequent. The only vocalization recorded is a hissing alarm snort which is immediately repeated by any other Goral in the vicinity, when heard. A captive Goral lived 11 years (Dover, 1933).

#### Genus HEMITRAGUS Hodgson, 1841

##### HEMITRAGUS JEMLAHICUS

*Hemitragus jemlahicus* H. Smith, 1826 — Himalayan Tahr. The Himalayan Tahr occurs throughout the Pir Panjal mountain range in Kashmir but it never seems to have crossed west of the Jhelum River in recent times. Its distribution therefore stops just east of the border of Azad Kashmir and it does not occur anywhere in Pakistan though this has been occasionally claimed, (e.g. Wildlife Enquiry Committee Report 1969).

#### Genus CAPRA Linnaeus, 1758

Goats occur throughout the mountainous regions of north Africa, the Middle East and South West Asia. They are pre-eminently adapted to arid but rocky regions and there are five recognized species of which three occur in Pakistan, with four identifiable subspecies of *Capra falconeri* besides. It is generally believed that domesticated goats have descended from *Capra hircus*.

#### Key to the Genus CAPRA

Goatlike appearance with pronounced sexual dimorphism, males being larger and with bigger horns. Males with pro-

nounced beard or tuft of hairs under chin and with slender compressed horns. No sub-orbital glands. No knee tufts. No inguinal glands, pit glands generally in fore-feet only.

#### Key to the Pakistan Species of CAPRA

- (i) Males with conspicuous dorsal crest of darker upstanding hairs and long scimitar shaped horns with prominent anterior keel, being elliptical in cross section (see Fig. 54). Females beardless. Adult males with no neck ruff but short black hairs in throat and chest region.  
... *Capra hircus*
- (ii) Males with no conspicuous dorsal crest and horns flattened anteriorly and bearing widely spaced rounded transverse ridges or bosses. Under fur densely woolly in winter in both sexes.  
... *Capra ibex*
- (iii) Males with slight dorsal crest and horns twisted outwards in a spiral. The horns are laterally compressed to form a keel which twists around the axis of the horn. Females generally with small beards. No dense under-wool in winter coat but adult males developing long chest ruff.  
... *Capra falconeri*

**Taxonomy:** D. L. Harrison (1968) considers that the name *C. aegagrus* for the Persian and Sind Wild Goat, takes pre-

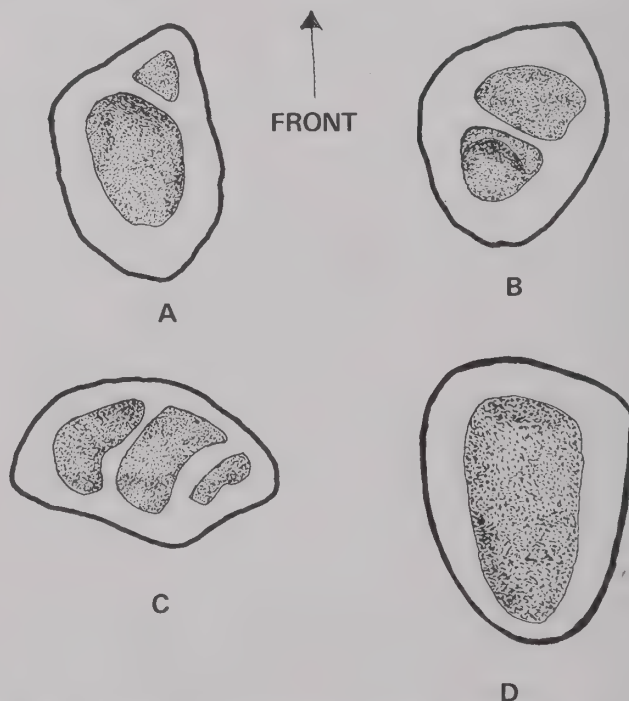


Fig. 54 Showing difference between bony core of horns of wild goat species in Pakistan. Drawings show appearance of sections cut through left side horn near base, of adult male in all cases. The anterior portion of the horn is at the top.

A. *Capra falconeri chialtanensis*.

B. *Capra hircus blythi*.

C. *Capra falconeri jerdoni*.

D. *Capra ibex sibirica*.

Note the appearance of these bone cores substantiates the view that *chialtanensis* is probably a subspecies of *C. hircus* whilst *C. falconeri* is a distinct species as also *C. ibex*.

cedence over *C. hircus*. However for the sake of consistency, Ellerman and Morrison-Scott (1951) is followed here. Some zoologists consider that *C. hircus* and *C. ibex* are no more than subspecies of a single polymorphic superspecies *C. hircus* (Van den Brink, 1967). It is true that all the wild goats have the same chromosome number and that inter-breeding between different recognized species occurs freely in captivity and even in the wild (see text and Hatt, 1959). They are, however, strikingly different in appearance and in Pakistan the populations are either allopatric or ecologically distinct.

#### Subgenus CAPRA Linnaeus, 1758

#### CAPRA HIRCUS

*Capra hircus* Linnaeus, 1758; Wild Goat, Persian Pasang, Cretan Wild Goat (see Illustration 56).

Synonym *Capra aegagrus* Erxleben, 1777.

Subspecies *Capra hircus blythi* Hume, 1875; Sind Ibex.

**Description:** Pakistan specimens found in the dry mountainous areas of southern Baluchistan and eastwards to Sind Kohistan, do not differ much in appearance from the wild goat populations found on certain remote islands in the eastern Mediterranean or across the Taurus Mountains of Turkey, or the Elburz Mountains of northern Iran.

They are rather stocky animals with thick-set bodies and

strong limbs terminating in broad hooves. Females, and young males, till their second winter, are a yellowish-brown varying to reddish-grey with a darker brown mid dorsal line extending from between the shoulders to the base of the tail. The females are beardless but carry short backward curving horns which may measure up to 150mm (6in.) over the curve and bear fine striations or annulations towards their base. Mature males are spectacularly beautiful, with long sweeping scimitar shaped horns over 102cm (40in.) in length and almost silver white bodies offset by sooty grey chests, throat and face. The extent of white hairs in the hind neck and body region of males increases with age. The hair in summer coat is short and coarse and even in adult males is more reddish-buff in colour. In northern Kalat specimens develop considerable underwool in the winter coat. Adult males have a dorsal crest of longer black and grey hairs which extends from a point just in front of the shoulders to the croup. This tends to make the old bucks look bigger and higher at the shoulder when viewed from a distance. The belly and outside of the lower limbs, beard and forepart of the face varies from black to deep chestnut-brown in mature males. There is also a conspicuous black stripe in adult males, running from the withers down the front of the shoulders merging with the black chest. Females and younger males show a characteristic face pattern with a dark stripe running from the corner of the eye to the muzzle and a similar dark brown area on the front of the muzzle and forehead with a paler yellow-grey line in between. This face pattern shows up well from a distance. The Hima-

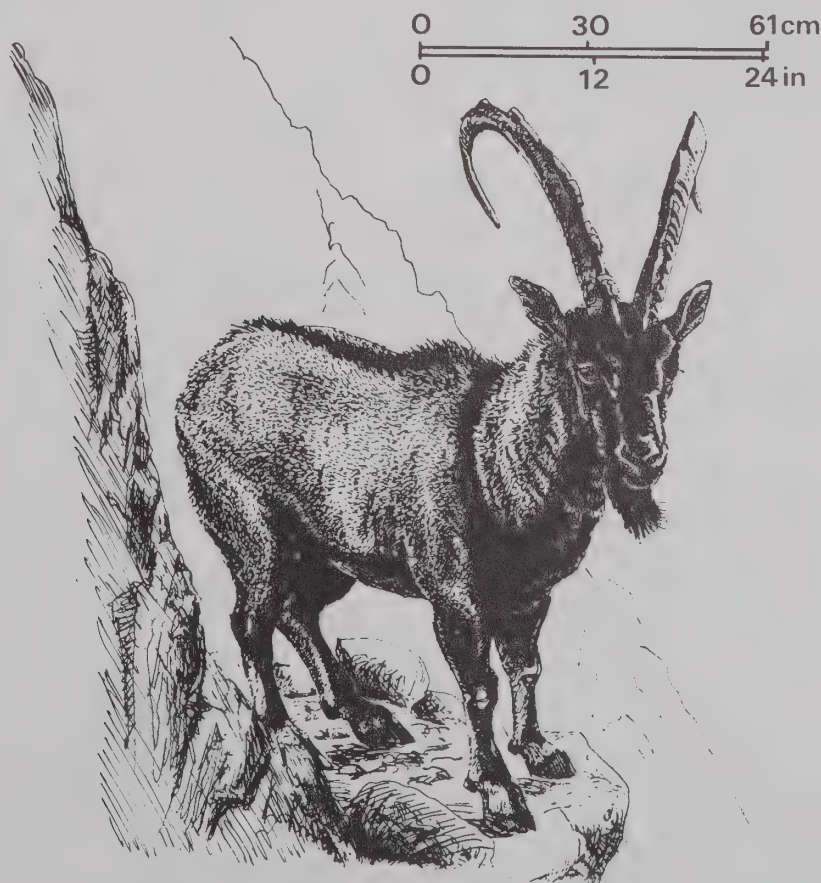


Illustration 56 *Capra hircus*: Persian Wild Goat or Sind Ibex. (Based on captive specimen  $4\frac{1}{2}$  year old male from Koh-i-Maran Hills, Baluchistan. Horns based on trophies from Kirthar Range, Sind, in possession of Syed Asad Ali.)



layan Ibex does not have it. Older males however have most of the face dark. Specimens from Sind Kohistan tend to be paler and much more slender in build than the Baluchistan population with no underwool even in winter coat. The knees on the fore-legs are covered by naked grey callosities (see Fig. 52) and in specimens observed in Sind there is often an extensive naked callous on the bottom of the sternum reminiscent of that borne by a camel (Roberts, 1967). A specimen from Kalat however, lacked this callous on the breast. The lower part of the hind and fore-legs is greyish white with a conspicuous pattern of black hairs down the front of the shank and extending round the fetlock (see Fig. 52). The horns, which often describe a  $270^\circ$  arc, are strongly keeled in front, sweeping upwards and outwards with the tips generally diverging. The front keel often bears irregular knots or protuberances. The iris is a golden brown, darker than that of the Markhor, the pupil contracting to a horizontal slot. The tail is very short and covered with long black radiating hairs, its under surface is naked. It has been noticed that the soles of the hooves of fresh killed specimens are whitish in colour and of a rubbery consistency quite unlike the hard hooves of wild sheep species. Moreover the second and fifth digits consist only of rough rounded horny knobs which are quite loose and completely detached from the cannon bone. Both these features appear to be valuable ecological adaptations for this animal's almost unbelievable acrobatic skill in climbing or descending vertical rock cliffs (Roberts, 1967). Specimens from Kalat tend to bear shorter horns, thicker at the base and they are also shorter legged and more thickset in body than specimens from the Kirthar range in Sind. The illustration of this species in Prater's revised edition (1965) does not show the black throat and chest, nor does it clearly show the characteristic black and white pattern of the fore-legs.

Adult males of this species measure 1.3–1.4m (52in.) from nose tip to root of tail, with the tail 12–15cm ( $4\frac{3}{4}$ – $5\frac{3}{4}$ in.) long. The shoulder height in males from Sind is 85–95cm ( $33\frac{1}{2}$ – $37\frac{1}{2}$ in.) and in females 55–60cm ( $21\frac{3}{8}$ – $23\frac{5}{8}$ in.). According to E. Walker (1964) adult males may weigh up to 120 kg (260lb) though 70–90kg (154–200lb) would be about average and females weigh from 50–55kg (111–120lb). A five year old male from Koh-i-Maran Hills in Baluchistan, however, measured only 74cm at the shoulder and weighed 45kg (99lb) with the horns 87cm, measured over the outer curve, and it would appear as though the weights quoted by E. Walker are too high.

The world record length of horn was shot in the Kirthar Range in Sind in 1870 by General E. C. Marston and measured 133.4cm ( $52\frac{1}{2}$ in.) with a basal girth of 17.8cm (7in.). Another head measuring 133.2cm ( $52\frac{7}{16}$ in.) with a girth 19cm ( $7\frac{1}{2}$ in.) was shot in the same region in November 1912 (McCulloch, 1925). An average male has horns of about 107cm (42in.) when fully mature. R. Lydekker in his original monograph on the wild sheep and oxen (1898) refers to a captive buck from Sind being shipped to Hamburg Zoo in 1898 which had horns measuring 141cm ( $55\frac{1}{2}$ in.) but there is no subsequent verification of this measurement which seems unlikely (Lydekker, 1898).

**Distribution and Status:** They can survive almost at sea level and in fact do so in some of the remoter cliffs around Ormara. They inhabit mountain crests up to 11,000ft in the Koh-i-Maran Range. Their main requirement seems to be precipitous crags, where domestic goats and shepherds cannot climb, and where they can be safe from disturbance. They are capable of surviving in very arid desert regions where the vegetation is sparse.

The most intriguing aspect of this species' distribution in Pakistan lies in the fact that its range meets that of the Markhor but generally does not overlap. Their ecological requirements, seem to be essentially similar, and in my opinion, the separation of their distribution ranges seem to be the result of close intraspecific competition rather than any unsuitability of their habitat. Wild goats are found in all the higher and more extensive mountain ranges of southern Baluchistan from the Mekran coastal range at Pasni right across to Sind Kohistan and the Kirthar Range in the east. Northwards they extend throughout Kalat up to the Koh-i-Maran Range of mountains which lie about 72km to the south of Quetta. A few 'Chiltan Goats' also occur on the Koh-i-Maran hills according to reliable accounts of local game wardens (Major S. A. Khan, pers. comm. 1972). The next substantial range of hills to the north is the Chiltan range on which is found the very distinct Chiltan Goat (see account of *Capra falconeri*, p. 200). It is reported that a few *C. hircus* survive in one isolated pocket on Ghadabar Ghar range of hills east of Loralai (Arbab Yahya, Forest Ranger, pers. comm. 1972) and



*Capra hircus*

Distribution Map 72 Wild Goat or Persian Pasang.

a survey in April 1973 by Dr Schaller (pers. comm.) showed from horn remains that *C. hircus* did exist alongside *C. falconeri* on this range and may in fact still survive in very small numbers.

Elsewhere this Ibex is found in the Kolwah Kupp range in northern Mekran, (Hamid Ali, Divisional Forest Officer, pers. comm., 1971) and on the Shah Narani Hills on the eastern border of Kalat, as well as the Pat range and Khudo range in Las Belas. There is a game reserve for Ibex in the Hingol Range in Central Mekran and they also occur in various parts of the Mekran coast range including the cliffs around Ormara.

This wild goat used to survive in the Marri Mungkthar Hills of Sind Kohistan about 30 miles north of Karachi and the last definitely known specimen was shot in this range in 1964 (Dr. Rizvi, pers. comm., 1971).

Elsewhere this wild goat extends from the eastern Mediterranean including the islands around Crete, through the Taurus Mountains in north Turkey, the Russian Caucasus, Iraq and

Iran where it is widely distributed in every mountain range (Lay, 1967).

In all the areas where the wild goat now survives in Pakistan it has to face severe competition from goat and sheep flocks; mainly the former. These domestic flocks compete for sparse fodder in times of drought as well as carrying the risk of disease. There is also constant hunting by local villagers and in the remoter areas it is difficult to enforce any game laws. Numbers in the Hinglaj Reserve of the Hingol Range of mountains are believed to have been severely depleted by such poaching (Syed Asad Ali, pers. comm.). Fortunately the Kirthar Reserve west of Hyderabad which extends for about 12 miles in a north-south axis and which is roughly two to three miles in width, may still have a population of 400–500 Ibex, and has been well preserved in recent years under the jurisdiction of the Sind Government.

**Biology:** This wild goat is gregarious and if undisturbed, will congregate in fairly large herds. In the Kirthar Reserve in Dadu district of Sind it was still possible to see a herd of over 70 individuals in 1971. The older males associate with such herds but generally keep together, often on the periphery of the main band. Small groups of males do sometimes remain in quite separate herds numbering four or five up to 15 or 20 individuals. When not disturbed, they graze in the early morning and in the late afternoon only lying down in what little shade is available for the hottest middle hours of the day. Where disturbed, they are much more wary and ascend into inaccessible crags very early in the morning, emerging again just before dusk. During the hottest part of the year, viz. May and June, before the monsoon influence, they lie up more extensively during the day and may graze a considerable part of the night. They will browse the leaves of *Salvadora oleoides* and of *Acacia senegal* and *Zizyphus nummularia* which grow on the steep hillsides. In studies in the Kirthar hills (unpublished) Dr. Schaller observed 80 per cent of preferred food was grass in September after monsoons, but in March when grass was dry about 46 per cent of food was obtained by browsing. In typical goat fashion they commonly stand on their hind legs in order to browse the higher branches and if any stunted tree grows out at an angle from a rock fissure, they think nothing of walking out on the narrow stem and stretching for the furthestmost twigs even if there is a sheer drop of many hundreds of feet below them. During the monsoon months as well as the winter, they do not need to drink as they get enough moisture from grazing herbage in the early morning when the dew has condensed, but from March to June they may visit accessible springs or water holes. Many observers (Col. Stockley, 1931 and Dr. Schaller, pers. comm., 1973) believe that they can exist indefinitely without drinking free water however and certainly this would be a necessity over large parts of their range. There is an authentic instance, of three Sind Ibex from the northern part of the Kirthar Range having jumped into an artificially dug brick lined well in order to drink. This well was situated in the Las Belas plain some considerable distance from the mountain range. It was apparently about 4.3m (14ft) deep, with vertical walls and a local farmer surprised the three animals in the early morning when he came to draw water. One of these animals succeeded in jumping out but the farmer managed to kill the other two before they could escape. The story might seem incredible to anyone who has not seen the way in which these goats can make a standing leap 1.75m (5–6ft) upwards on to a seemingly vertical rock surface, and carom off this another 1.75m (5 or 6ft) upwards onto another equally smooth and precipitous surface.

Older males particularly like to retreat into natural rock caves or crevices during the heat of the day, and even when grazing domestic flocks or shepherds are in the vicinity of such caves they will lie quietly hidden from view.

In Sind and Las Belas, where there is considerable monsoon influence, the rut occurs at the end of this season, starting in early September and lasting up to the end of October and young are thus born from late January to end of March. In northern Kalat, however, in the higher mountain ranges the rut takes place in November and December and the young are born in April and May. Observations in the Kirthar revealed that in contrast to the behaviour of Markhor males, which actively roam from one female band to another, large groups of Ibex males remain constantly with the female herd during the rut (G. Schaller, pers. comm., 1973). Only the largest dominant male succeeds in mating with most oestrus females, the younger or weaker males being readily driven off. Actual fights or physical clashes were observed to occur very rarely (G. Schaller, pers. comm.). In the Kirthar females usually have their first young when three years old. The gestation period seems to vary from 150 to 155 days (G. Schaller, in lit.). A captive male in my possession from the Koh-i-Maran Range in Baluchistan, exhibited full rut behaviour from late October until the early part of December. A captive female mated on 29 and 30 October by the same male produced twins on 18 April after an apparent gestation period of 170 days. Since the populations in Sind Kohistan and northern Kalat are less than 150 miles apart this marked difference in the periodicity of the rut well illustrates the extent to which ecological adaptations enable different populations to take advantage of the optimum season for parturition. Spring is the period of maximum growth in Baluchistan and except in the immediate coastal area there is little monsoon influence. When there have been good showers and there is adequate vegetation, nearly every female produces twins. When the monsoon partially fails it has been observed in the Kirthar that the majority of females do not breed at all and single offspring are more common. In the Kirthar Hills in 1972 after poor monsoon rains it was observed that all females had only single offspring by the beginning of October (G. B. Schaller, pers. comm.). The baby kids have soft silky fur which is a paler grey and less reddish-brown than the adults. They suckle for four to five months but thereafter the mother butts them when they try to suckle. Even after weaning they remain closely attached to her, often lying close against her body up to the age of seven or eight months when resting. It has been observed that the young remain attached to their mother even after she comes into oestrus (when the young are about seven months of age) but this attachment dwindles by the time the next kid is born. Newly-born kids can stand and run about two hours after birth and when hardly seven days old have been observed trying to follow their mother when she fled before human approach. At this time, the baby kids made repeated attempts to jump up steep rocks, often slipping and falling back but apparently without serious injury.

Leopards are probably the main predator on this wild goat, and hyaenas may also occasionally take the young kids. In the more accessible hill ranges they are hunted by man for meat as well as trophies. Young kids call their mother by bleating in a voice indistinguishable from baby domestic goats. Adults have an alarm call which is an explosive sort of snort which from a distance can sound almost like the 'beep' of a motor car horn. Both sexes give this warning snort.

Comment has already been made on the wonderful agility of these goats. They appear almost slow and deliberate when traversing rock faces but can slide without injury down rock



surfaces which are almost perpendicular with drops as much as fifteen to twenty feet. They sit back on the entire tarsus of the hind leg when thus sliding and no doubt the outer nails or toes, on the fore-feet help in braking their descent. They have a wonderful sense of balance and examination of movie film sequences shows that they cross their legs and lean their body inwards or outwards with unerring sense of balance in order to maintain their equilibrium on steep slopes. They can turn round almost by placing all four feet one after the other on the same spot and even when they appear to have reached the point where retreat or return is impossible they can extricate themselves by sliding vertically downwards or turning round on the same minute piece of rock.

Observation on a captive male during the rut indicated that it curled its tail tightly over its back almost continuously and solicited females by extending the neck and stretching out its head in a straight line with the horns laid over its back. If the female was coming into oestrus it further solicited her by protruding its tongue, flippering this rapidly in and out. It also twisted its head sideways and this was a much more rapid movement than the twist observed in rutting Urial (*Ovis orientalis*) rams. Observation and comparison of this captive animal with a captive Urial ram indicated that the wild goat exhibited *flehmen* (upward curl of lips and nostrils) less frequently than the Urial and this was only after the female urinated and the male had sniffed the urine. When highly excited the male also lifted its fore-leg (*Laufschlag*) in rather abbreviated stiff pendulum movements and here again these were much less exaggerated movements and less frequently seen than those exhibited by rutting Urial. It also uttered

high pitched soft grunting calls when soliciting an oestrus female. Females also cock their tail up when excited.

When challenging another male these wild goats frequently stand up on their hind legs and at the same time bend their head to one side before charging forward and clashing their horns downwards on to their adversary. I have observed young females do the same thing in play. During the rut the most intense period of sexual activity is in the very early morning and it was only at this time that copulation was observed. Adult males have a strong goaty odour during this period, which is accentuated by their habit during the rut of arching their back and twisting round the head and neck and urinating on to their face and foreneck. At this time urine is expressed in strong jets forward. Outside of the rutting season, the male urinates by straddling its hind legs slightly and the urine trickles vertically to the ground.

### CAPRA IBEX

*Capra ibex* Linnaeus, 1758; Ibex.

Subspecies *Capra ibex sibirica* Pallas 1776; Siberian Ibex or Himalayan Ibex (see Illustration 57).

**Description:** Both the European or Alpine population and the Himalayan population share certain common distinguishing features. Unlike other wild goats there is no distinct white carpal patch on the foreleg, and the horns always have a flattened frontal surface bearing spaced transverse prominent corrugations. The horn is roughly triangular in cross section (see Fig. 54). The Ibex are somewhat heavy bodied and thick-

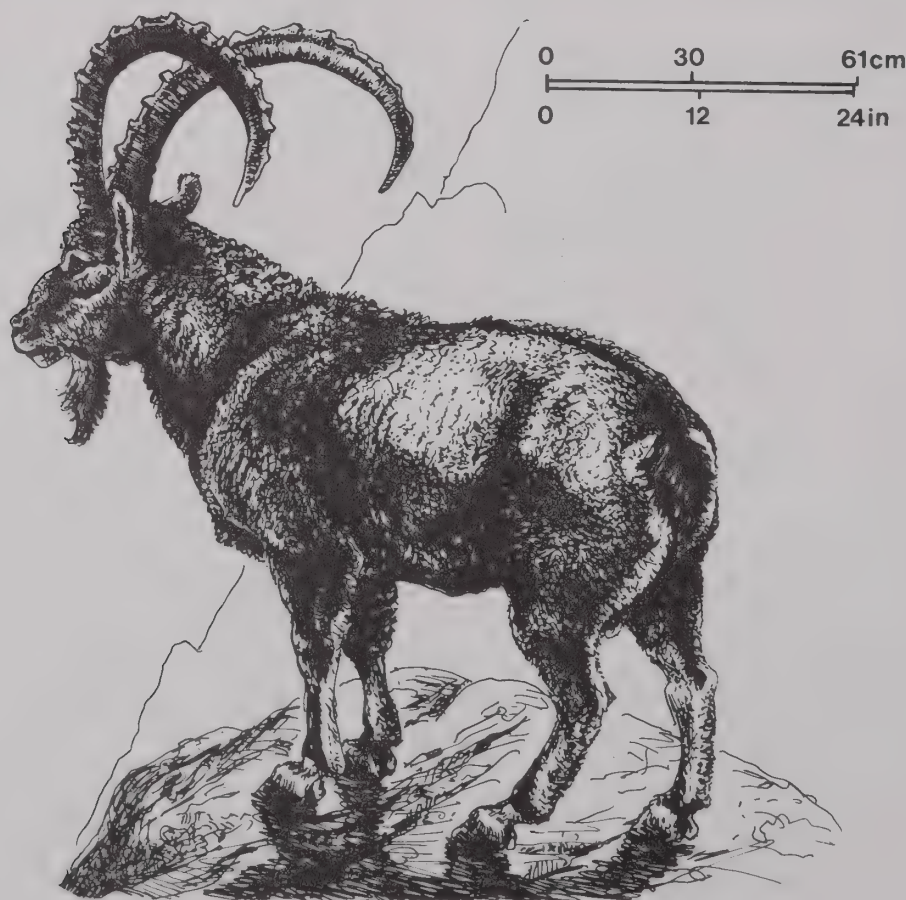


Illustration 57 *Capra ibex sibirica*: Himalayan Ibex. (Based on sketches of free wild specimens during late November, adult male from Shingaigah Nullah, Gilgit.)

set even when compared to the other wild goat species, and have short sturdy legs.

The Himalayan Ibex can be separated from the Alpine population by the horn shape which in adult males grows much longer, curving round to form three-quarters of a complete arc and tapering to relatively slender points. The mature males also have much paler body colouring with predominantly white or creamy hairs on the flanks when in winter coat.

There are few reliable records of weights but Colonel C. H. Stockley (1926) records three specimens of adult males from Baltistan weighing 88kg (193lb), 85.3kg (188lb) and 88.8kg (196lb) respectively. In a subsequent book he claimed that adult bucks may weigh up to 90kg (200lb) (Stockley, 1936) and a recent account of the European Ibex from the Gran Paradiso Sanctuary refers to males reaching 153kg (337lb) in weight (Koller, 1972). Col. Ward (1924) gives the weight of a female at 47kg (104lb). It has been observed by many hunters that Ibex in the Himalayas lose considerable condition in winter due to the harsh living conditions and it is probable that the same individuals could gain up to 20kg (44lb) by the end of the summer. The shoulder height varies from 95cm (37.5in.) to 101.7cm (40in.) (Stockley, 1926) with the head and body length from 145 to 165cm (Sokolov et al., 1963). Females are about one third smaller, standing up to 81.3–89cm (32–35in.) at the shoulder and weighing 50–55kg (110–121lb).

The record horn length from Pakistan measured 140cm (55in.) and came from Gilgit (Ward, 1924A). It had a basal girth of 26.5cm (10½in.) and a width of 63.5cm (25in.) between tips. The majority however do not develop horns measuring much more than 101.6cm (40in.) and certainly in Gilgit a head with horns over this length would be considered an exceptionally good trophy. A head with horns of 127cm (50in.) was however shot in Chitral in 1968 (Major S. A. Khan, pers. comm.). The population of this Ibex living in the Tien Shan mountains in the north western part of Turkestan produces the biggest animals and horns of over 145cm have been obtained from there (Lydekker, 1907). Females bear backward curving horns which are slender and oval in cross section without the front part being flattened. They measure up to 27.9cm (11in.) and bear small closely spaced annulations or rings and are thus quite distinct from the flattened keeled horns of female *C. bircus* or *C. falconeri*.

The horns of an adult male are large and impressive despite the bulk of the animal, and the rounded horizontal ridges or bosses on the front of the horn are close set in the proximal region, becoming gradually more widely spaced and shallower towards the distal one-third. Many old hunters in Gilgit and Baltistan claim that there is one ridge or notch for every year of the animal's life, and this could be approximately true for some individuals. Mature animals develop from 14 to 21 such ridges. But a 2½ years old buck examined by me had seven such bosses or frontal ridges and another aged buck estimated to be between 11 and 12 years of age carried 20 such ridges.

Females and young males are a reddish-tan or almost a golden colour in summer coat with a greyer-brown appearance in winter due to an admixture of white hairs. Older males have a rich chocolate-brown colour in summer with circular patches of yellowish-white hair in the mid dorsal and rump regions. In winter there is more white hair and considerable variation in overall colour, some old bucks having the upper part of the neck and shoulders entirely white as well as the flanks. The winter coat is dense thick and woolly and cracks like the fleece of domestic sheep, and at this season old males look positively massive and hardly smaller than the local breeds of

hill cattle. The underwool of the Ibex, particularly in the lower regions of the belly and flanks, has long been prized for producing the softest and most luxurious quality of wool for weaving cloth. It is known in Kashmir as 'Pashm' and was highly prized in the Moghul courts four hundred years ago. The story is told of a fine woollen shawl presented to one Emperor which would pass through a wedding ring.

In both sexes there is a thick woolly beard. In adult males this may reach 17–20cm (7–8in.) in length. The ear is thickly fringed inside with woolly hair and the short tail is bushy and covered with long black hairs. Both sexes have a mid dorsal dark brown stripe extending from the shoulders to the root of the tail and there is an indistinct pattern of darker brown hairs on the fore part of the legs which includes the knee and spreads round the fetlock of both fore and hind feet. The iris is a darker golden-brown than that of the Markhor.

**Distribution and Status:** Confined to the relatively arid mountain ranges of the inner-Himalayas, living well above the tree line only in the higher more precipitous regions. They occur from about 3660m (12,000ft) to over 6710m (22,000ft) in Pakistan, though they sometimes migrate from one mountain range to another in winter and in so doing have been seen crossing valleys below 2135m (7000ft) (Mr. Manzoor-ul-Haque, one-time Divisional Forest Officer in Baltistan, pers. comm., 1967). They often descend to feed on relatively open grassy slopes but during the middle of the day and at night ascend to the steepest, less accessible crags.

They are fairly widespread through the higher mountain ranges of Baltistan in the Karakoram Range, the Haramosh Range, and the Deosai. In Gilgit, they are still fairly plentiful in Ishkoman, Yasin and Hunza. Further west they occur in the Hindu Kush range of mountains and throughout northern Chitral down to about 32km north of Chitral Bazaar (Colonel Khush Wakht, pers. comm., 1970). A few Ibex still occur in the highest ranges to the north and west of Garm Chashma in western Chitral but apparently not south of this on the west bank of the Chitral river. In 1972 a herd of about 30 adult males was observed in the Bestal Nullah, a tributary



*Capra ibex sibirica*



of the Arkari. They also occur around the Agram Pass with Afghanistan (G. Schaller, pers. comm., 1972).

In southern Gilgit and Hazara district small populations still survive in the higher mountain regions of Chilas district and on the slopes of Mali-ka-Parbat. They are also known to occur in Indus Kohistan though there are no reliable reports from this remote region as to their present status.

A very few Ibex still survive in the Safed Koh range in the North West Frontier Province and this is the southernmost limit of its range. Horns seen in the Scouts' Mess at Parachinar indicate a much smaller animal than the Himalayan Ibex.

There is no definite evidence of Ibex occurring in Dir but they do occur in the northern mountain ranges of Swat Kohistan.

Extra-limally this Ibex occurs in the extreme north eastern part of Afghanistan, through the Pamir range and Tagdumbash, the Altai mountains in the USSR and south to the Tien Shan Mountains (Flint et al., 1965). They are widespread in Tibet and occur in India only in the western Himalayas from the Pir Panjal range to the west bank of the Sutlej river (Col. Stockley, 1936).

Compared with the Markhor (*C. falconeri*) or Sind Ibex (*C. bircus*) this wild goat appears more plentiful and its future survival is not endangered in Pakistan, largely due to the inaccessibility of its habitat provided by the very extensive concentration of very high mountain ranges in the extreme north western regions. Baltistan undoubtedly is the stronghold of the Himalayan Ibex in the region today.

**Biology:** The Himalayan Ibex is gregarious like all the wild goats, but possibly because of its slightly more inaccessible habitat or better grazing at higher altitudes, it usually occurs in larger herds than the Markhor. Young males, females and their followers normally associate in small herds varying from seven or eight up to 30 individuals in Gilgit, according to my observations. In the higher remoter mountain regions of Baltistan, they may still be encountered in herds of up to 40 or 50 individuals (Brig. Aslam Khan, pers. comm., 1967). During winter and early Spring the mature males also associate with such herds, though they generally tend to congregate on the periphery and to prefer each other's company. In the summer and early winter however the older males live apart from the female herds, usually in groups of two or three. I have observed that one aged buck will frequently be accompanied by one or two younger males. One such, with horns estimated to be 102cm (40in.) which must have been between eight to ten years of age, was accompanied by a two and a three year old buck both of which seemed to be following the older male. In late December the rut commences and males then rejoin the female herds.

Feeding activity appears to be confined largely to early morning and late afternoon even in fairly remote regions where the Ibex are not too much disturbed. In summer and autumn they graze mainly on grass tussocks which clothe the higher mountain slopes and in Gilgit above 12,000ft, where the principal species is *Enneapogon persicum*. Winter feeding conditions are harsh due to heavy snowfall at these altitudes and Ibex have to dig for forage and may often be dependent upon browsing the leafless twigs of bushes such as the Wild Currant (*Ribes emodense*) and the alpine willow (*Salix himalayensis*) which generally grow in the moister gullies even up to 4300m (14,000ft) elevation. In the early Spring the Ibex are half starved and eagerly seek new sprouting grass when it is available at lower milder elevations. This is the only time when they descend as low as 2450m (8000ft) and are thus

much easier to hunt, a fact well known to the local villagers in Gilgit and Chitral.

The rut in the Himalayan Ibex starts about 10 days later than that of the Markhor in the same regions, which is a valuable ecological adaptation to their life at a higher altitude. It commences towards the third week of December in Gilgit and Baltistan and lasts till mid January. S. H. Prater (1965) states that the rut occurs in October in the Himalayas and this may be possible in the eastern part of the Ibexes' range though unlikely since they do not occur within Indian territory east of the Sutlej river.

The gestation period is given (Crandall, 1964) as 155 to 170 days.

During the rut, males actively seek out and pursue oestrus females and frequent fights between rival males also occur. In such fights, the opponents typically rear up on their hind legs with the head twisted to one side, in a similar manner to the Markhor, before charging downwards on their adversary. Males have also been observed fighting by standing broad-side to each other and trying to hook their opponent with their horns (Walther, 1962). More detailed studies of free wild populations have been made on the European Ibex which also reveals similar fighting behaviour (Nievergelt, 1967). Males have also been observed making a threat display by lowering the head until the horns almost touched the ground (Walther 1962). The behaviour of the male towards an oestrus female is closely similar to that of *C. bircus*. The tongue of the male (which incidentally is black in colour) is extruded and the neck outstretched with the nose pointing straight outwards. The head is at the same time jerked or twisted sideways and the tail is held tightly curled over the back, as the male approaches or solicits the female (Walther, op. cit. and Nievergelt, op. cit.).

The young are born towards the end of May or early June in Gilgit and probably in the same season throughout Pakistan. Twins are common though singles also occur more frequently in some localities (Col. Markham in Jerdon, 1884). One old game warden in the Shingai-Garh Nullah in Gilgit stated that the majority of females bear twins (Muhammad Ibrahim, pers. comm., 1965). The new-born kid lies in some sheltered hollow for the first few days of its life while the mother forages in the immediate vicinity. There is an interesting record with a photograph of a natural hybrid occurring in Kishtwar region of North Kashmir, between a domestic goat and a Himalayan Ibex (Ward, 1926). The young are weaned between four and five months of age. Observations at the end of November in Gilgit region showed that up to that time the young still showed a close attachment to and followed their mother.

Snow Leopards (*Panthera uncia*) are reported to prey upon Ibex (Burrard, 1925 and Stockley, 1936). In Baltistan and the Deosai plateau where Ibex occasionally are found in broader upland valleys, wolves may also occasionally be able to overcome them though Ibex would presumably be able to retreat to inaccessible ground in most regions where they occur. Man is, as usual, the most serious predator on this species. I have found skulls of recently killed female and young male Ibex around shepherds' summer camp sites in Gilgit. They also run the risk of infection from domestic goat flocks in the summer as these graze in almost the same ground ascending to the crests of the higher mountain ridges. Ibex have also been reported as being heavily infected in summer by the parasitic Bot fly (*Hypoderma* sp.) whose larvae can be found under the skin of the buck (Stockley, 1936). The Alpine Chough (*Pyrrhocorax graculus*) often settles on the back of feeding Ibex and it could well be that they can feed on various ectoparasites as well as the Bot larvae. This bird also remains

throughout the winter at high altitudes and there may thus exist an interesting symbiotic association between the two species.

The ability of the Ibex to remain even in winter at very high altitudes is dependent upon some interesting ecological adaptations. Apart from their very thick insulating winter pelage, they seem well able, with their sturdy legs, to dig for forage in deep snow as well as to break through and traverse snow drifts. During a blizzard or snow-storm such as frequently occurs at these altitudes and which may last for up to 24 hours, the Ibex lie amongst the shelter of the rocks, often half buried in snow. Their thick woolly coat protects them and they are able to dig themselves out after the snowfall

Himalayan Ibex has lived for over 22 years (Crandall, 1964). It is probable that Ibex even precipitate avalanches by crossing ravines filled with loose snow since they do not hesitate to plunge into such snow. Similar habits and fatalities have been observed in a band of Rocky Mountain Goats (*Oreamnos americanus*) a species adapted to exactly similar terrain. The oldest trophy head examined by me showed 11 annular rings and was a specimen with the cheek teeth almost worn down to the gums. It would therefore seem probable that 10 to 12 years is the normal life span in the wild.

Females and young males have a most peculiar alarm call which is a birdlike chirrup and quite unlike the alarm sneeze of the Markhor. Young Ibex bleat when they wish to attract

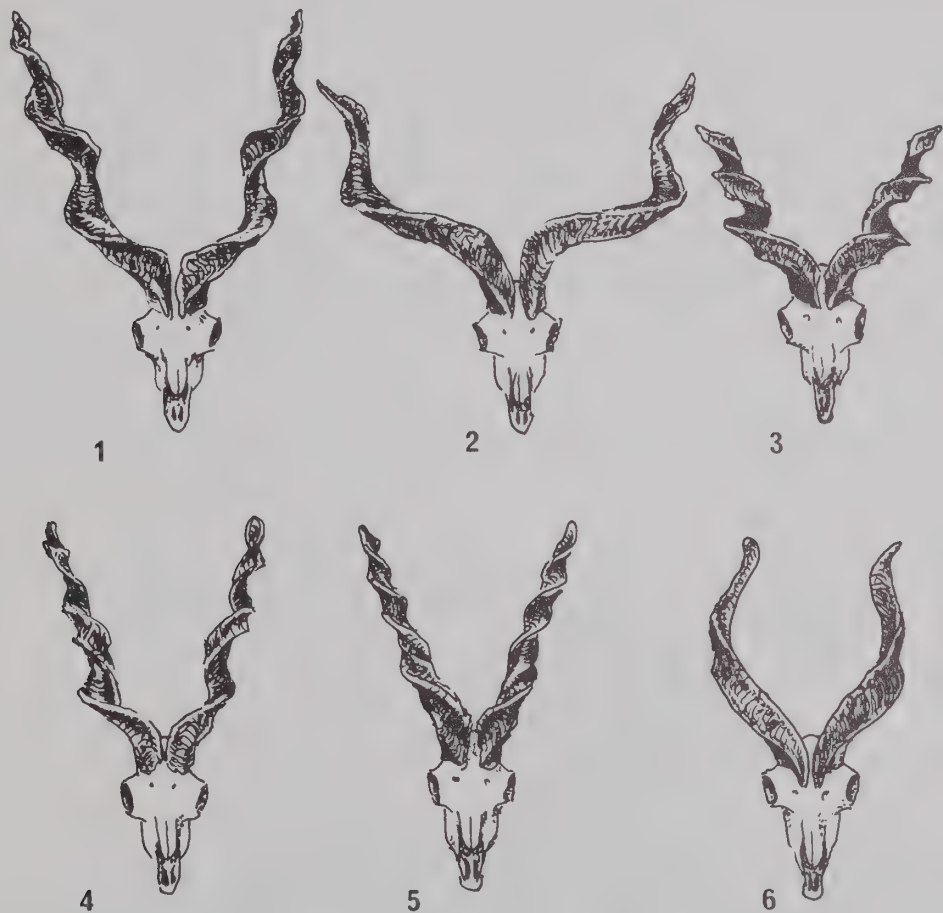


Fig. 55 Showing typical heads of mature male Markhor representing six major subspecies.  
1. *Capra falconeri cashmiriensis*. The Pir Panjal or Chitral population.  
2. *Capra falconeri falconeri*. Astor, Gilgit.

- 3. *Capra falconeri heptneri*. Badakhshan, USSR.
- 4. *Capra falconeri megaceros*. Kabul and Safed Koh.
- 5. *Capra falconeri jerdoni*. Suleiman and Baluchistan.
- 6. *Capra falconeri chialtanensis*. Chiltan race.

ceases and to descend to more wind-swept slopes where they can dig down with their fore-feet to expose clumps of grass and make up for their enforced fast. Another frequent hazard of these higher mountain regions is that of snow avalanches, particularly towards the end of winter. Earlier writers have commented that many Ibexes are killed by such falling avalanches (Jerdon, 1874 and Stockley, 1928). T. H. Braham whilst climbing the 5100m (17,000ft) Malika-Parbat in the Kaghan valley in 1967 came across the preserved remains of a four year old male Ibex in the bottom of a gulley which was in the passage of frequent avalanches. This was in early June and the body was just becoming exposed by melting snow. A captive

their mothers. Whilst watching a group of three adult males, I have observed that all three went through the motions of pawing the ground with the fore-legs before settling down to rest. Since the ground was rocky and there did not seem to be any particular effect in clearing loose stones from such scraping, this appeared to be a ritualized movement.

**Subgenus ORTHAEGOCEROS** Trouessart, 1905

In all other respects a genus of typical goats, but placed in this separate subgenus because of the peculiar twisted horns borne by the males.



## CAPRA FALCONERI

*Capra falconeri* Wagner, 1839; Markhor

Subspecies *C. f. falconeri* Wagner, 1839; Astor Markhor (see Illustration 58).

*C. f. cashmiriensis* Lydekker, 1898; Pir Panjal Markhor

*C. f. megaceros* Hutton, 1842; Kabul Markhor

*C. f. jerdoni* Hume, 1875; Straight Horned Markhor

*C. f. chialtanensis* Lydekker, 1913; Chiltan Markhor (for a separate account see page 200)

**Description:** The words 'mar' and 'khor' in Pharsi (Persian) mean snake eater and most writers about this wild goat make some speculative comment as to how the appellation arose. The name much more probably arose as a corruption of the Pushto words 'mar' (meaning snake) and 'akhur' (meaning horn) — an apt allusion therefore to the serpentine shape of their horns.

There are seven distinct subspecies of Markhor recognized by Ellerman and Morrison-Scott (1951) and these can be fairly clearly separated on the basis of horn shape. There is also considerable variation in size between the northern Himalayan population and those inhabiting the hotter drier mountain ranges to the south. Thus the northern races stand 99–101.5 cm (39–40 in.) at the shoulders with an adult male from Astor being 186 cm (73.5 in.) in head and body length (Ward, 1924C). A second adult male from Haramosh in Baltistan also representing the larger northern population measured 104 cm (41 in.) shoulder height and 185 cm (73 in.) from nose tip to root of tail. A female from the same region stood 72.4 cm

(28.5 in.) at the shoulder with the head and body length 149.8 cm (59 in.) (Stockley, 1926B). An adult male from Baluchistan representing the southern population was 89 cm (35 in.) shoulder height and measured 132 cm (52 in.) from nose to root of the tail (Stockley, 1926B). Weights have been variously estimated as varying from 100 to 109 kg (220–240 lb) for an adult male from Astor (Ward, 1924C). A mature (4½ year old) captive male from the Kargah valley, Gilgit, was estimated by me to weigh not more than 80 kg (176 lb). It was in fine condition and Col. A. E. Ward's estimates would appear to be too high. Regrettably there are no recorded weights for the Baluchistan population.

The horns in the nominate subspecies are very massive in good specimens with a basal girth of 28 cm (11 in.) and a length measured along one keel of up to 114.35 cm (45 in.) (Lydekker, 1907 and Stockley, 1936). Specimens of the subspecies *C. falconeri cashmiriensis* can have equally massive horns with an even greater length, 165 cm (65 in.) measured along the curve, being on record (Lydekker, 1907 and Prater, 1965). Horns of the subspecies *C. falconeri jerdoni* are smaller and rarely grow longer than 91.4 cm (36 in.) measured straight. The variation in horn shape is best explained by Fig. 55, showing typical heads of the four or five subspecies here recognized as occurring in Pakistan. It will be seen that in all cases the horns are closely approximate at the base and that the frontal keel always twists outwards and backwards so that the spiral turns anticlockwise in the right horn. In the southern population the keel is quite closely twisted and the axis of the horn is approximately a straight line. In the northern races the horns have a more open twist, diverging outwards, and reaching their extreme form in the nominate subspecies which often has

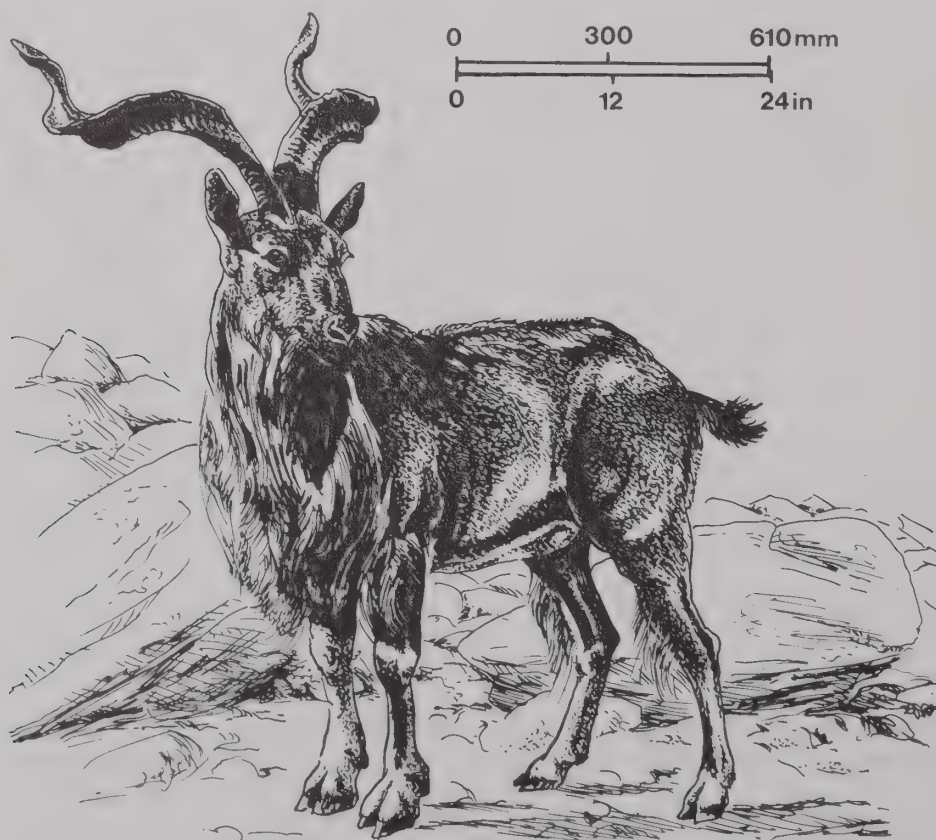


Illustration 58 *Capra falconeri falconeri*: Astor Markhor. (Based on captive specimen in possession of Pakistan Air Force, 4½ year old male in winter coat, captured in Kargah Nullah, Gilgit.)

horns with only one complete twist of  $360^\circ$ . Females of the northern races have horns measuring up to 35.6cm (14in.) in length, slender and usually bearing one and a quarter twists near the tip, and diverging outwards. Females of the Baluchistan population have horns measuring between 15.3 to 17.8cm (6–7in.) when mature and these generally show only one twist in their distal portion.

It must be stressed that there is considerable individual variation in horn shape and length and that these subspecies do not always comprise distinct populations. Thus horns of *C. f. megaceros* and *C. f. cashmirensis* occur in the same regions in Chitral, and in Gilgit both *C. f. falconeri* and *C. f. cashmirensis* type horns occur within the same region according to Col. Stockley (1931).

In appearance they are sturdy animals with strong relatively short thick legs and broad hooves. Both sexes are a reddish-grey colour with more yellowish-buff tones in summer coat and more grey in winter. The tail, which is naked in its ventral surface, is short and sparsely covered with longer black hairs. It lacks the bushiness of the tail of *C. ibex*. The belly and legs are creamy-white with a conspicuous dark brown pattern on the fore part of the shank interrupted by a white carpal patch. Both sexes have a mid dorsal dark brown stripe extending from the shoulders to the base of the tail. According to my observations of animals in the field, the females of the southern Baluchistan population do not show any beard, but in the northern population the females do have a small chin tuft. Adult bucks develop much white and grey in their pelage in winter coat and they also have a very extensive black beard followed by a shaggy mane of long hairs extending down the chest and from the fore part of the neck. This consists of grey and white hairs with white predominating. There is also a crest of long black and dark brown mixed hairs down from the shoulders to the croup but this is not upstanding like that of *C. bircus*, the dark hairs tending to hang like a mane down either side of the spine. The beard is also much thicker and longer than that of *C. bircus*. In the northern races, adult males also develop tufts of long white hairs on the elbow and stifle (knee). In the southern population adult males develop a much shorter and less conspicuous neck-ruff but they have the same conspicuous greyish-white body colouring. The illustration in *The Book of Indian Animals* showing a male with horns of the *C. f. jerdoni* type but long shaggy hair is misleading. Even in winter coat the flanks and belly have short hair and of a much redder tone (Prater, 1965). In winter coat very little underwool is developed even in the northern populations, the body fur being relatively short and harsh in contrast to the thick fleece of *C. ibex*. There is considerable individual variation in the amount of grey or white hairs in the coat of older males and in mid December in Gilgit I have seen a male with 35in. horns (estimated to be under four years old) with most of its body creamy-white, whilst another male observed at the same time and estimated to be over 10 years (horns nearly 50in.) had only white around the chest, the rest of the body being reddish-grey (Roberts, 1969).

It is noteworthy that the horn colour of males tends to be brownish whilst the horns of *C. bircus* are more bluish-black.

**Distribution and Status:** Typically associated with steppic mountain conditions and regions of meagre erratic rainfall, Markhor are quite adaptable ecologically, being found at from 600m (2000ft) elevation in the completely treeless hot and arid hills of the southern part of the Suleiman range up to 3600m (12,000ft) in the Himalayas in association with juniper and birch scrub forest. They avoid the higher altitudes frequented by the Himalayan Ibex and stick to the more pre-



- Capra falconeri falconeri* (stippling)  
*Capra falconeri cashmirensis* (horizontal lines)  
*Capra falconeri megaceros* (dots)  
*Capra falconeri jerdoni* (vertical lines)  
*Capra falconeri chialtanensis* (white box)

Distribution Map 74

Astor Markhor.  
 Pir Panjal Markhor.  
 Kabul Markhor.  
 Straight-horned Markhor.  
 Chiltan Markhor.

cipitous mountain sides, never feeding on the more open alpine slopes frequented by the latter species.

They are associated with *Quercus ilex* scrub forest in Chitral and with *Pinus gerardiana* and *Juniperus macropoda* scrub forest in the northern part of Baluchistan and south Waziristan.

*C. falconeri falconeri*: The Astor Markhor is confined to Gilgit region and its real stronghold is on the slopes of the Nanga Parbat Massif. It also occurs on both sides of the Astor River and up the Indus valley as far as the Haramosh range in south western Baltistan. It is absent from the northern parts of Baltistan as well as northern districts of Gilgit such as Yasin and Ishkuman. There is some overlapping of this subspecies with animals carrying horns of the Pir Panjal type, particularly in Haramosh. Heads of the nominate subspecies have been shot in Rondu, Baltistan (Logan-Home, 1914) which is south of the Indus. Probably the greatest concentration of this subspecies is now to be found in the Kargah Nullah which has been protected as a hunting preserve of the Gilgit Scouts. It is estimated that this valley and its tributaries holds about 500 head (Roberts, 1969). A few small herds also survive in the Naltar valley which is also preserved. They used to occur in Chilas but reports indicate that the Markhor population is precariously small throughout this southern district of Gilgit.

*C. falconeri cashmirensis*: The Pir Panjal, or Kashmir subspecies, occurs in Chitral from about 40 miles north of Chitral town, southwards into Dir and westwards into Swat Kohistan. They occur on the slopes of Ludak Sar and Mankial in Swat Kohistan and in Indus Kohistan. A very few also occur in Azad Kashmir but only one small herd estimated at 15 to 20



individuals in the western extremity of the Kajinag Range (Major S. A. Khan, 1972, in lit.) — the remaining Markhor in tributaries of the Neelum valley close to the ceasefire line have all been exterminated in recent years by troops stationed in this frontier region (Major S. A. Khan, in lit.). Probably the main concentration of this subspecies is now in the Chitral Gol sanctuary (a former hunting preserve of the Mehtar of Chitral) which is estimated to hold about 150 head (Schaller and Mirza, 1971A; and Schaller, in lit., 1973), and the Tushi valley just north of Chitral with about 125 head (G. B. Schaller, in lit., 1973).

The subspecies *C. falconeri megaceros* intergrades with that of *C. falconeri jerdoni* in Pakistan territory and it is probably not a distinct population. However heads of this type have occasionally been shot in the southern border region of Chitral as well as in south eastern Swat State in the Murghazar Hills where a very few still survive. They also survive precariously in the Khanori hills of the Malakand Agency as well as the Sakra range just north east of Mardan (R. F. Nana, in lit., 1967 and 1970). A very few also still survive in the Safed Koh range in the Upper Kurram valley (Colonel Dastagir, 1969, pers. comm.) and several heads in the Scouts' mess at Parachinar shot in the 1930s are fine examples of this subspecies which is in danger of extinction throughout its range. They used to occur in the lower hills around Bannu (Stockley, 1926A) as well as throughout the Khyber Hills (Burrard, 1925). They have almost been exterminated from all these lower mountain ranges in the North West Frontier Province and were believed to be extinct in the Shaikh Badin hills (late Nawab of Kalabagh, Malik Amir Mohammed Khan, pers. comm., 1966) but a herd of about 20 was reliably reported in this range south of Bannu in 1973 (Dr. Schaller and Major S. A. Khan, in lit.). They are also reported to survive in very small numbers in the ranges on both sides of Landi Kotal in the Khyber Pass (Major S. A. Khan, pers. comm., 1973). In 1925, Major Burrard reported that they occurred throughout the Peshawar hills down to Gomal.

*C. falconeri jerdoni*: The straight-horned or Suleiman Markhor is more widespread but also severely restricted in numbers. It occurs in scattered isolated populations on all the major mountain ranges immediately to the north and east of Quetta, i.e. Murdar, Takhatu, Zarghun, Kaliphat and Phil Garh. In the south eastern extremity of the Suleiman range a few still survive in the Gurchani hills (Syed Asad Ali, pers. comm.). Perhaps their greatest concentration today is in the Toba Kakar range north of Hindu Bagh and on the borders with Afghanistan, including the Tor Ghar Hills west of Fort Sandeman. No reliable information has recently been available from Waziristan but Markhor probably still survive in the higher mountain ranges contiguous with the Afghan borders such as Pir Ghal and Momin where they used to occur in the 1940s. They still definitely survive in the Blue Pine (*Pinus excelsa*) forests of the Shingar Range on the borders between Baluchistan and South Waziristan.

Outside of Pakistan, a very few Markhor survive in Nuristan region of Afghanistan and these animals appear to be of the subspecies *C. f. cashmiriensis* (Dr. Heinrich Klockinhoff, Afghanistan Zoological Committee, in lit.; and Ahlemann, 1970). An estimated 50 to 80 belonging to the subspecies *C. f. megaceros* still survive precariously further south in the mountain regions of Asmar 35°30'N, 71°20'E (IUCN Red Data Book).

In India, the Markhor is practically at the extreme limit of its range and occurs only in the Pir Panjal range. Here the subspecies *C. f. cashmiriensis* occurs and it is reported to have been practically exterminated by troops stationed in these

border regions (M. K. Ranjitsingh, Chairman, Survival Service Commission, Himalayan Fauna, 1969, pers. comm.). The Russian population belongs to the subspecies *C. f. heptneri* and is found mainly in the Kuhitang plateau of Uzbekistan (Sokolov et al., 1963).

There is plenty of evidence from talking to responsible people in such places as Chitral, Gilgit, Bannu and Kalabagh that the Markhor has declined drastically in numbers during the past 30 years. This is attributed to indiscriminate use of firearms by the local populace in all the more accessible hill ranges, particularly in the North West Frontier Province — the Suleiman Hills and more accessible valleys of Chitral and Gilgit. Another undoubted factor is the increased competition from grazing domestic goat flocks particularly in competing for the limited available forage. Since the total world population of this unique and impressive looking animal survives largely within Pakistan territory, the country has a special responsibility to ensure its continued survival.

A consideration of the present and former known distribution of the various described subspecies of Markhor indicates that it would have been more logical to make *C. f. cashmiriensis* the nominate race since the so-called Astor Markhor *C. f. falconeri* is more restricted in distribution, and also inhabits the periphery of its total known distribution.

**Biology:** Markhor are gregarious and the females with their followers and young males, regularly associate in small herds. The restricted nature of the terrain frequented by Markhor sometimes results in association of large herds. In some of the Baluchistan mountain ranges where competition from domestic goat flocks has driven the Markhor population to the upper limits of the mountain crests, larger concentrations or herds result. In Gilgit in less disturbed conditions the biggest herd seen by me numbered 13 individuals with groups of three to five more usual. In the Chitral Gol region where they are protected, a herd of over 30 scattered individuals has been seen (Major S. A. Khan, pers. comm.) and in the Tushi reserve in January 1973 a herd of 92 (G. B. Schaller, in lit.), also about 25 individuals on Takhatu in one herd (J. A. W. Anderson, pers. comm.). Usually they do not congregate in such large herds as either *C. bircus* or *C. ibex* regularly do, and eight to nine would be an average herd size.

Mature males invariably live solitary lives and frequent more inaccessible crags, joining the female and immature male herds only during the rut.

They are diurnal in feeding activity with greatest activity in the early morning and late evening but in mid winter they have been observed in Chitral feeding intermittently throughout the day (G. B. Schaller, pers. comm.). I have also encountered herds actively feeding in Gilgit at 11am and 3pm in late November. In the spring and summer months they graze principally on tussocks of grass and in Gilgit the principal species which is grazed would appear to be *Pennisetum orientale* and to a lesser extent *Enneapogon persicum*. When the grasses are dried up they will also browse on the leaves and twigs of bushes such as *Hippophae rhamnoides* and *Pistacia integerrima* in Gilgit. In Chitral in winter their principal food is the leaves or acorns of the Holly Oak *Quercus ilex*. G. B. Schaller and H. B. Mirza (1971C) observed them climbing even up to 7.5m (25ft) above ground in such trees to browse and jumping from bough to bough in almost unbelievable fashion. Though characteristically associated with wormwood bushes (*Artemisia maritima*) they have not been observed to browse this plant if grasses or other forbes are available.

Earlier writers tend to stress the Markhor's intolerance of snow and cold and its habit of migrating in the mid winter to

lower altitudes (Burrard, 1925; Stockley, 1926; and Prater, 1965). The older males will seek female herds at lower altitudes during the rut period of December, but they frequent regions where winter snowfall is in any case light and the steepness of the terrain always affords some exposed feeding slopes. I have observed a young male Markhor in mid November at an elevation of over 3660m (12,000ft) when there was about 15.25cm (6in.) of snow cover. At this elevation the night temperature dropped to  $-7^{\circ}\text{C}$  ( $21^{\circ}\text{F}$ ). They seem well able to resist cold and even at lower elevations, temperatures are equally low in winter. Their migration nearer to valley mouths or to lower slopes during the later part of the winter may be more the result of rutting activity than aversion to cold. Markhor will drink, usually seeking water towards late afternoon but in areas where they are much disturbed or where water is only available at valley bottoms they have been reported as descending only with extreme caution after darkness. During most of the day the older males lie up in some well sheltered rock overhang or if possible actually inside a natural cave. During the early winter and post monsoon season, it has been observed that these older males only emerge to forage for a bare hour each morning and evening and they do not seem to need much food.

The rut starts in late October in the southern part of their range and lasts about one month. In the northern Himalayas the rut starts in early December and is generally over by the end of that month. At this time the males possess a very pungent goaty odour. They descend to lower slopes to seek out female herds and appear to attach themselves to one particular territory or herd. Fighting occurs between rival males at this season but much less frequently than with Urial rams according to the observations of Dr. Schaller (1971B and 1971C). Major Amanullah Khan (pers. comm., 1969) observed one such fight in Chitral which took place in deep snow and lasted about 20 minutes. The larger male constantly circled round above the younger animal, cutting off its retreat, and both tried to hook sideways with their horns standing broadside on to each other. A captive male in Gilgit reared up on its hind legs with its head held sideways preliminary to attacking any intruder during the rut (Roberts, 1969). F. Walther observed that when captive Markhor males were fighting, one individual always tried to get onto the upper slope above its adversary (Walther, 1962). He also recorded a mild form of agonistic behaviour in which the buck stands broadside on to an intruder and tucks in its chin so that the horns are displayed vertically. He called this gesture impressing and I observed the same threat display by a  $4\frac{1}{2}$  year old captive buck in Gilgit, during the rutting season whenever a stranger approached its enclosure.

Males will solicit females to urinate by nudging them in the rump, to test their oestrus condition but they do so less frequently than the Ovidae, according to the observations of Dr. Schaller. He also saw males occasionally urinating over their fore-neck and twisted round muzzle, as has been observed in wild and captive *C. bircus* during the rut (G. B. Schaller, pers. comm.). The male will exhibit flehmen (the curled upper lip) after sniffing the urine of females according to my observations in Gilgit. I also observed that during the rut, when the master buck moved off to a fresh piece of ground, the females tended to stop grazing and to follow him (Roberts, 1969). Bucks will actively pursue oestrus females during this period, often chasing them at considerable speed. (G. B. Schaller, pers. comm.).

A captive female in my possession was mated when about 30 months old and gave birth to its first young when exactly 36 months of age and this would appear to be the normal

age for reaching sexual maturity. It was kept with a mature male during the rut when it was 18 months old, but did not become pregnant.

The gestation period varies from 162 days to 170 days according to my observations on a captive female specimen of the subspecies *C. falconeri jerdoni*. L. S. Crandall quotes Asdell as stating that the gestation period is 135 days (Crandall, 1964). Twins are quite commonly born and there is an authentic record of wild born triplets in Chilas district of Gilgit (Pottinger, 1911). A small group of three females observed by me in Gilgit in late November each had twins. Young Markhor definitely stay with their mother until the rutting season or even until the next young is about to be born. After this the female will drive the older young away if approached too close according to my observations of captive Markhor. Schaller observed that older males tolerate the young during the rut and when one was pursuing an oestrus female the half-grown young (8 months of age) often ran, trying to keep up with their fleeing mother. Newly born Markhor remain lying in a sheltered hollow for the first several days of their lives and the mother has been heard making a special characteristic call when approaching her newly born young at this time (Burrard, 1925) indicating probably that it is safe for it to emerge to suckle. When about  $1\frac{1}{2}$  months old, the young Markhor frequently kneels to suckle and they develop this habit when foraging also.

Snow Leopards (*Panthera uncia*) prey upon Markhor in Gilgit and Chitral. Out of 16 Snow Leopard scats examined by Dr. Schaller in Chitral, five contained Markhor hairs. Wolf tracks have been commonly seen by me in areas where Markhor forage, but it is not known whether they are ever able to run them down before the Markhor is able to retreat into precipitous rocky regions where it would be at a distinct advantage over the wolf. Golden Eagles (*Aquila chrysaetos*) are quite numerous in the regions frequented by Markhor and they may occasionally succeed in taking newly born Markhor kids. Man is however the most serious predator and local villagers hunt them very heavily during the winter when Markhor descend to more accessible hillsides and meat is in any case a rare luxury. A young male Markhor shot in January in Chitral was found to have its back infested with larvae of the Bot fly (*Hypoderma* spp.) (Claus Winkler, pers. comm., 1967). In parts of Chitral in 1966 many wild Ibex and Markhor were reported to have died from an epidemic. This was suspected to have been Rinderpest introduced by domestic goat flocks (Prince Burhan-ud-Din, pers. comm.).

Markhor have a similar alarm snort to *C. bircus* — it is perhaps more of a sneeze sound but quite explosive and capable of carrying several hundred yards. Both sexes when excited carry their tails curled over their backs.

The oldest age record for a captive Markhor is 10 years (Dover, 1933) though other wild goat species have lived up to 18 years (Walker et al., 1964) and it is significant that a very experienced local Game Warden in Gilgit claimed that he had known individuals living up to 18 years (Mohammed Ibrahim, pers. comm.). The oldest trophy head that I have been able to examine indicated an animal of 10 years and it is probably that in the wild, few survive beyond 11 or 12 years of age.

Markhor have been seen in Gilgit grazing within the vicinity of Ibex in the Shingair valley (Roberts, 1969) but generally speaking the Ibex keep to higher ground and there is no recorded physical interaction. In the southern extremity of the Markhor's range it has met with *C. bircus* in the past (Maydon, 1937) and there is evidence for believing that the two species have hybridized (see Chiltan Markhor below, p. 200).



**CAPRA FALCONERI CHIALTANENSIS**

*Capra falconeri chialtanensis* Lydekker, 1913; Chiltan Markhor (see Fig. 55)

**Taxonomy:** First described as a distinct subspecies by Lydekker in 1913 this wild goat was well known to local hunters and sportsmen even before this date and several writers had suggested that it might be a hybrid between the Straight Horned Markhor and the Persian Pasang (Nicol-Cumming, 1908 and Burrard, 1937).

The Chiltan Goat certainly appears to be quite a distinct and unique population, and the present author considers that it may well have derived as a result of natural hybridization. However Dr. Schaller after studying both populations intensively and on the basis of horn morphology, feels convinced that *C. falconeri chialtanensis* will prove to be but a subspecies of *C. bircus*.

**Description:** Females are more or less indistinguishable from female Markhor of the *C. f. jerdoni* population. They are reddish-grey in colour with a dark brown mid dorsal stripe from shoulder to rump and creamy-white legs bearing conspicuous dark brown pattern on the fore-part of the shank with a white knee (carpal) patch and the dark brown spreading around the base of the fetlock. The males, as they reach their third or fourth winter, have an increasing amount of white and grey hairs in the mid dorsal and shoulder regions. According to observations by G. B. Schaller and Z. B. Mirza, some males have darker brown almost black chests (pers. comm.) a feature not shown by the Straight Horned Markhor but typical of the Persian wild goat and they may also show a shoulder stripe as in *Capra bircus*. Such a marking lends support to the theory that the Chiltan Goat has close relationship with *C. bircus*. The horns are the most striking feature in adult males (see Fig. 55). Quite unlike the adjacent population of *C. f. jerdoni* with its tightly twisted corkscrew spiral, they are intermediate in shape between those of the Markhor and Wild Goat (Persian Pasang). They normally have just under one complete spiral being strongly keeled and flattened in cross section like the horns of *C. bircus*. Examination of typical *C. bircus* heads from northern Kalat State with typical *C. f. jerdoni* heads from Zarghun or Takhatu suggests that the horns of the Chiltan male more resemble those of *C. bircus*. Adult bucks of the subspecies *C. f. jerdoni* invariably have horns with the keel showing two and a half to three complete spirals. A good head of the Chiltan Markhor rarely measures more than 73.6cm (29in.) measured over the curve.

**Distribution and Status:** It is now apparently confined to three populations on three hill ranges of which the greater part survives on the Chiltan just south west of Quetta with very small numbers on Murdar immediately to the east and Koh-i-Maran to the south of Chiltan. On the Chiltan range, these animals inhabit the more precipitous south western facing slopes. During five days survey in November 1970, it was estimated that the total population in the Chiltan range was around two hundred (107 individuals were actually seen) (Schaller and Mirza, 1971A). According to reliable accounts of local hunters in Quetta, substantiated by horns of a male specimen shot from that part, a very small remnant population survives in the Murdar Hills and this may be as few as 12 to 15 individuals. In Koh-i-Maran they exist alongside normal *C. bircus* individuals.

It is significant that these hills form the exact boundary dividing the populations of *C. bircus* which extends south-

wards from the Koh-i-Maran range and *C. f. jerdoni* which extends northwards and eastwards from Quetta. Pure populations of *C. f. jerdoni* are found on all the suitable adjacent ranges such as Takhatu and Zarghun though it is interesting to note that Major Burrard, writing before 1925, stated that the Chiltan Markhor was also found on Takhatu and Zarghun mountain ranges besides the Chiltan range. It seems likely that in earlier times there could have been more admixture of adjacent wild goat populations. (See Distribution Map 74.)

Fortunately the Chiltan range has been declared a game reserve and the Government of Baluchistan is aware of the unique importance and zoological interest of this wild goat. However at the present time shooting of Chiltan Markhor is still allowed on permit and the population does suffer extensive disturbance and competition from domestic goat flocks. Because of its accessibility to Quetta city, the Chiltan mountains also offer constant temptation to poachers and there is evidence that such hunting regularly occurs (Dr. Schaller, pers. comm., 1970).

**Biology:** They are gregarious and diurnal in feeding and have similar habits to the straight-horned markhor. The rut was observed to start slightly earlier however, commencing from mid October and females probably coming into first oestrus at the beginning of November. By the third week of November the rut is practically over (Schaller and Mirza, 1971A). The gestation period is believed to be 160 days and twins appear to occur quite frequently, the young being born from the end of March to early April.

**Genus PSEUDOIS Hodgson, 1846**

A monotypic genus containing one endemic Himalayan species which shows characteristics intermediate between sheep and goats (Ward, 1924B). They have smoothly cylindrical horns more reminiscent of the Caucasian Tur (*Capra caucasica*) in shape and outline, and are goatlike in their climbing ability as well as absence of sub-orbital pit glands.

**Key to the Pakistan Species of PSEUDOIS**

Sheeplike in appearance. Males with massive cylindrical horns diverging widely which are smooth not wrinkled on their surface. Females with small compressed horns not so divergent and only two mammae. Sub-orbital glands absent but inguinal pit glands present.

... *Pseudois nayaur*

**PSEUDOIS NAYAUR**

*Pseudois nayaur* Hodgson, 1833; Bharal or Blue Sheep (see Illustration 59).

**Description:** The Bharal is similar in size and shape to the northern race of the Wild Sheep or Shapu (*O. orientalis vignei*) except for being slightly shorter legged and more stockily built. The adult males are strikingly handsome animals with a slaty blue coat in winter, offset by white legs and belly, with a conspicuous blue-black stripe down the fore-part of the shanks and another horizontal stripe dividing the white belly from the grey flanks. Adult males also have the chest and fore-part of the neck blue-black. This leg and chest pattern is similar to that of mature males of the Persian Pasang (*C. bircus*). There is no trace of any chest ruff in adult males nor any beard. The face is characteristically patterned with the fore-part of the muzzle and forehead being darker in both

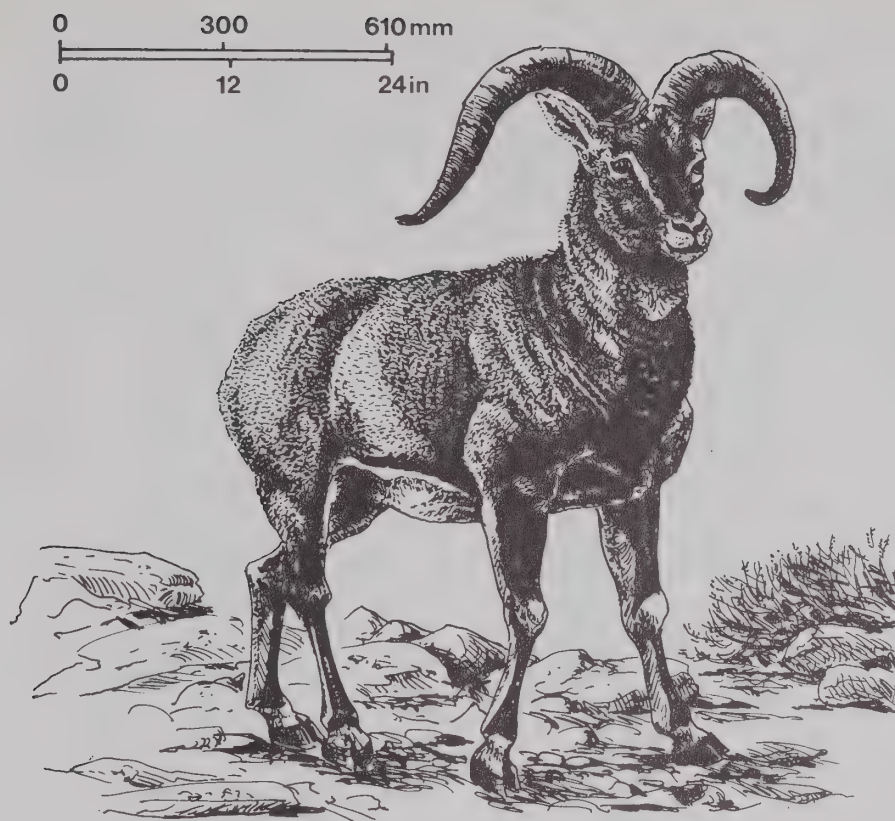


Illustration 59 *Pseudois nayaur*: Bharal or Blue Sheep.  
(Based on photographs of three fresh killed males  
secured by second American expedition to K2, Kara-  
korum Mountains, Baltistan.)

sexes (almost blue-black in adult rams) and another less distinct dark stripe from the corner of the eye down to the mouth, separated by a paler creamy line. Again this face pattern is similar to that exhibited by *C. bircus*.

In summer coat the underwool is shed in ragged patches and the fur becomes reddish-grey in colour. It is harsh and springy to feel like that of *Ovis orientalis* but with much thicker underwool in winter. In both sexes the tail is slightly longer than in typical wild sheep and covered with black hairs giving it a bushy appearance.

The horns of mature males are cylindrical and very broad at the base, curving almost horizontally outwards. Unlike those of all true sheep they lack any corrugations on their surface and they tend to be dark olive black in colour in contrast to the yellowish horn colour of true sheep. After rams reach five or six years of age the tips of the horns bend downwards and backwards (see Fig. 56). This is difficult to observe from a distance and many younger males appear to have longer horns because their tips grow straight outwards. In Baltistan horns usually average 58–61 cm (23–24 in.) in length with a basal girth of up to 33 cm (13 in.) (Sterndale, 1884). Further east in Indian territory they attain a greater size and the record from Ladakh is 84.5 cm (33½ in.) (Burrard, 1925). A captive three years old ram had horns measuring 33 cm (13 in.), (Bailey, 1911). Males do not have any strong goaty odour during the rutting season (Sterndale, op. cit.), and like the Ovidae both sexes have inguinal pit glands (Ward, 1924B).

Females are smaller than the rams and never develop any black pattern either in the chest region or flanks. They do however have a similar dark grey-brown pattern over the muzzle and a less distinct black and white leg pattern. Their

horns are relatively short and curve slightly outwards. They are closely approximate at their base in contrast to those of the female Shapu. Females have two mammae.

The head and body length varies from 1.3 to 1.4 m (4¼–4½ ft) with a shoulder height of 70–89 cm (27½–35 in.) and tail length 13–20 cm (5¼–7¾ in.) (Jerdon, 1874 and Walker et al., 1964). Females weigh from 50–55 kg (110–121 lb) and males up to 60 and 70 kg (132–154 lb) (Stockley, 1926B).

**Distribution and Status:** Bharal are confined to the northern ranges of the Himalayas at great elevations. They are rarely found below 4500 m (15,000 ft) and in summer may regularly occur up to 6500 m (21,500 ft). Thus they live in relatively arid mountain steppe country beyond the monsoon influence and above the limit of tree growth and are typically associated with broad stony valleys and shale ridges at the foot of higher mountain peaks, in regions characterized by extreme cold in winter and aridity throughout the year.

In Pakistan the Bharal is only found in the remotest northern region of Hunza and the Karakoram range in Baltistan. It has been recorded as occurring in 'considerable numbers' around Shimshal (Wing Commander Shah Khan, 1968, pers. comm.), as well as the Passu valley (Lydekker, 1907), both regions in upper Hunza. It also occurs in the Karakoram around Shigar, and around the Baltoro glacier in Baltistan.

Extra-limitally, Bharal extend eastward into Ladakh and the Himalayas as far as Sikkim and Nepal. Northwards they extend through Tibet and Mongolia into extreme south western China in Szechuan and Shensi (Ellerman and Morrison-Scott, 1951). They do not occur in Russian territory.





Fig. 56 Showing difference in appearance of Bharal rams' horns according to age.  
A. Upper front and side views of mature (over 7 years) male.  
B. Same of specimen approximately four years of age.

Bharal were considered fairly numerous in these remote inaccessible regions as hunting pressure from local nomadic shepherds remains at a fairly low level (Wing Commander Shah Khan, pers. comm., 1968). Due to the recent greatly increased strategic importance of this frontier region and especially the recent fighting between India and Pakistan, it is possible that the Bharal population may now be under increased hunting pressure from border troops. No amateur sportsmen have been allowed into these regions for many years.

Bharal and Siberian or Himalayan Ibex frequent the same ground in Baltistan but the Shapu does not apparently occur in the same territory.

**Biology:** They are highly gregarious and diurnal in feeding habits. Living in such remote mountain regions they do not suffer much human disturbance and may graze intermittently throughout the day especially in the early summer when succulent new growth is available. But they are principally active in the early morning and evening (Burrard, 1935 and Stockley, 1936). They may associate in herds of thirty to forty individuals but the mature rams usually keep in separate small bands of five to six and remain at higher remoter elevations than the female and young mixed herds. The males have been characteristically described as keeping as close as possible to the permanent snow line, even in summer (Stockley, op. cit.).



Distribution Map 75 *Pseudois nayaur* Bharal or Blue Sheep.

In summer there is some growth of alpine annual grasses fed by springs from the melting snow and the Bharal herds like to graze on open slopes which benefit from such springs. *Poa alpina* and *Poa pratensis* are common species in the Karakoram mountains above 13,000ft elevation (Webster et al., 1965) and these grasses probably provide an important part of the diet. In winter they must rely on browsing the thorny clumps of *Astragalus* spp. of which the most abundant from 12,000 to 13,000ft is *A. zanskarensis*. They also probably have to supplement their diet when snowfall is heavy with browsing on twigs of Alpine willow or even lichens and mosses.

Little is known about the breeding habits of the Bharal in the wild. Captain Bailey who spent three and a half years in the Chumbi valley (Indian territory north of Kulu) records captive born lambs being produced on 15 June and 8 August in that region but thought that most wild births occurred in June and July (Bailey, 1911). The Regents Park Zoo kept a small captive breeding herd from 1882 to 1908 during which 43 lambs were born, and 50 per cent of these were produced during June (Zuckerman, 1953). Earlier writers also indicate that the majority of young are born in June and July and that twins are common (Jerdon, 1874 and Sterndale, 1884). Crandall (1964) gives the gestation period as 150 days, but it appears that it might be longer than this. Walker (1964) states that the rut is in September but observation on Bharal on the Nepal-Tibet border by G. B. Schaller (pers. comm., 1972) indicated that the rut probably did not start till mid November, lasting till early December. There seems to be no basis for Prater's statement (1965) that the young are born from spring to early summer. At such elevations, snow melt and new growth of grasses does not occur until the end of May or even early June.

In the Regents Park captive herd, rams were observed fighting during the rut when they reared up on their hind legs before striking sideways with their horns. Their behaviour as observed by Dr. Schaller on the Nepal-Tibetan border is closely similar to the fighting behaviour of the true Caprinae and not a bit typical of the Ovidae (G. B. Schaller, pers. comm.)

In many of their habits the Bharal shows closer affinities with the true goats than sheep. When excited they characteristically raise their tails like goats. They also readily retreat to steep and craggy mountain areas when danger threatens and demonstrate an ability to climb over rougher steeper slopes than would be possible for any of the Ovidae (Jerdon, 1874 and Stockley, 1936). They have an alarm call which has been described as a 'sharp shrill whistle' (Jerdon, op. cit.), which would seem to be more akin to the alarm call of the Himalayan Ibex than the sneeze of wild sheep. Their normal reaction when first sighting danger, however, is to freeze and rely upon their protective colouration, by remaining motionless. If they believe they have been detected they then retreat to more precipitous slopes.

A captive female lived for 16 years (Dover, 1933). In Baltistan both Wolves (*C. lupus chanco*) and Snow Leopards share the same habitat and prey upon Bharal. Col. Stockley believed that in Ladakh, Snow Leopards subsisted largely upon Bharal (Stockley, 1928). In many parts of the Himalayas the meat of the Bharal is much esteemed by the local population who hunt it for food (Jerdon, op. cit.).

#### Genus OVIS Linnaeus, 1758

The six species generally recognized in the genus *Ovis*, are confined to the northern hemisphere and are circumpolar in

distribution, having populations in all the higher mountain masses both in the eastern part of Eurasia and the western part of North America.

The true sheep have a sub-orbital pit gland and also pedal glands in the fore and hind feet whereas goats lack these glands below the eye or in the hind feet. Male sheep may develop a chest ruff of longer hairs commencing from the angle of the jaws but never have a beard nor do they emit a strong odour during the rut.

In the Ovidae the adult rams tend to have massive horns, characteristically curving backwards and downwards in a broad arc when viewed from the side. The horn surfaces are heavily corrugated or wrinkled and triangular in cross section with each surface being slightly concave and the broad flattened base of the triangle uppermost.

#### Key to the Genus OVIS

Males with massive cylindrical widely divergent (outward curving) horns which are broadly flattened anteriorly and triangular in cross section. Horns bearing wrinkled annulations throughout. Lachrymal pits in skull, with sub-orbital glands. Inguinal glands and pit glands in fore and hind feet. Females with small compressed backward curving horns and two mammae.

#### Key to the Pakistan Species of OVIS

- (i) Large size. Males up to 110cm at shoulders. No long chest ruff in males but widely spreading spirally twisted horns which form more than a complete arc in adult specimens.  
... *Ovis ammon polii*
- (ii) Medium size. Males up to 80cm at shoulder. Males with conspicuous black chest ruff and horns usually forming less than a complete arc.  
... *Ovis orientalis*

#### OVIS AMMON

*Ovis ammon* Linnaeus, 1758; Argali  
Subspecies *Ovis ammon polii* Blyth, 1841; Marco Polo Sheep or Great Pamir Sheep (see Illustration 60).

**Taxonomy:** Recent studies on the sheep population of Asia have shown that the Tibetan argali (*Ovis ammon*) and its various subspecies are closely similar in all fundamental respects to the various populations of *Ovis orientalis* and that they in fact intergrade (Flint et al., 1965). Both these populations have therefore been united under one species *Ovis ammon* in recent studies. (Heptner et al., 1961). Natural hybridization between *O. ammon* and the *O. orientalis vignei* has been known to occur (Finn, 1929 and Ward, 1924A). Furthermore populations of *O. ammon* from the hills of Amur Darya in Uzbekistan represent a much smaller animal approximating in size to *O. orientalis* (Carruthers, 1949). It seems reasonable therefore to accept the view of Russian experts that the population of *O. ammon* at its western extremity intergrades with that of *O. orientalis*. The Ammon Sheep inhabiting the Eastern Tien Shan range as well as the Tarbagatai range in the north may be considered as part of the same *Ovis ammon* population though Russian authorities call them *O. ammon cycloceros*.

**Description:** Within Pakistan territory only the Marco Polo subspecies of the Argali, occurs. It is recognized by the





Illustration 60 *Ovis ammon polii*: Marco Polo's Sheep.  
(Based on photographs of fresh killed specimen, 54in. trophy shot Khunjerab Pass, Hunza by Captain G. A. Khan; also from photograph of trophy-head owned by Mr. W. Mumby from the same area.)

very long outward curving horns, developed in the mature males. An aged ram is surely one of the most impressive representatives of the entire order *Artiodactyla*, being not only the bearer of massive spiralling horns which can span a man's outstretched arms, but also being almost twice the height and size of most other wild or domestic sheep.

In summer the hair on the body is short and coarse and of a sandy-reddish colour with the face and breast having an admixture of grey and white hairs. The legs and belly are creamy-white without any darker pattern on the frontal part of the shin such as is found in the goats or the Bharal. In winter because of thicker underwool the animal looks bulkier and slightly greyer, with much white about the neck and chest in old rams. Not surprisingly the neck in rams tends to be heavy and muscular. The tail is short and not bushy and in both sexes the legs appear relatively long and slender when compared with the wild goats. There is a more extensive white area in the caudal region as compared to the Urial but this patch is not so conspicuous as in Bighorn sheep (*O. canadensis*). There is no long haired chest ruff in the rams as in the various races of Urial. A female exhibited in Regents Park Zoo in 1968 was exactly similar in colouration and horn development to an adult *Ovis orientalis* then in my possession, differing only in its greater size. Adult females bear horns up to about 13cm in length with slight annulation or wrinkles in the proximal part. In a mature ram, the horns curve outwards describing more than a complete arc, their distal quarter or third, forming another turn. They are broad and massive at their base as described above. For many years a skull and

horns of this species hung in one of Simla's hotels, which measured 190.5cm (75in.) along the outer or upper curve and its basal girth was 42.5cm (16 $\frac{3}{4}$ in.). Even in recent years heads measuring over 152.4cm (60in.) have been shot in the Wakhan just north of Chitral and a 154.8cm trophy was shot in 1969 from the Afghan corridor (Mellon Jr., 1969). In 1967 a 137cm (54in.) head was shot in Pakistan by Captain Gauhar Ayub on the Khunjerab Pass in Hunza. Recorded body measurements are scant but it is generally considered to be a slightly smaller animal than the Tibetan Argali, the latter standing 118cm (46 $\frac{1}{2}$ in.) at the shoulder (Stockley, 1926) compared with 110cm (43.5in.) shoulder height for *Ovis ammon polii*. One earlier hunter whose observations appear to be carefully made however describes male rams as standing 122cm (48in.) at the shoulder (De Poncins, 1895). Rams may weigh up to 113.5kg (250lb) (Prater, 1965) and Lydekker estimates the weight of an adult ram even higher at 308lb, but gives a shoulder height of only 41in. for a mounted specimen in the British Museum (Lydekker, 1911).

**Distribution and Status:** An inhabitant of very high mountain plateau regions subject to severely cold winds and rather arid climatic conditions throughout the year. There is some seasonal migration either to lower valleys or more southern mountain ranges in winter. In both cases, avoidance of deep snow is the factor determining the movement. They are only found from about 4500m (15,000ft) even up to 6100m (20,000ft) in the Pamir range of mountains. They



Distribution Map 76      *Ovis orientalis*  
    *Ovis ammon polii*

Urrial or Shapu.  
 Marco Polo's or Great Pamir Sheep.

avoid steep cliffs and precipitous rocky areas such as Bharal favour, and the range of these two species is allopatric.

The Marco Polo Sheep is not a permanent resident in Pakistan territory but migrates in early winter from Chinese Turkestan across the Khunjerab Pass into northern Hunza. It also migrates in winter from the Hindu Kush mountains across the Killick Pass further to the north west and also into Hunza. On these exposed rocky slopes the Marco Polo Sheep can find winter fodder which is apparently difficult in the northern facing slopes and higher parts of the Pamirs where snow lies deeper. In the early spring these sheep again migrate northwards into Chinese Turkestan or Afghan territory and the lambs are born outside of Pakistan. In the winter of 1968–69 which was estimated to be an exceptionally good year for Marco Polo Sheep in Hunza, the Mir of Hunza estimated a total population of about 1000 head within his territory (Malik Asad Khan, pers. comm., 1970). In a recent survey of the Killick and Khunjerab passes by Dr. Schaller he estimated that the total available suitable habitat within Pakistan territory for this sheep was hardly 25 square miles (Schaller, pers. comm., 1974).

Elsewhere, this magnificent sheep is more or less confined to the Pamir Plateau. On the western borders of Chinese Turkestan (Sinkiang) they are believed to have been much reduced in number by Chinese army personnel serving in the border areas. Further to the north west, their position is believed to be better, as they are protected in Russian territory and the Russian authorities stated in 1967 (Noel Simon, for IUCN, in lit., 14 June 1967) that they were particularly plentiful in the Tagdumbash Pamirs as well as the mountain ranges between the head waters of Irishik and Amu Darya including the Pamirs in the south east. The west half of the Pamir Range is not suitable habitat for this sheep. They are also preserved by the Afghan government in the Wakhan Corridor. The Russian authorities also state that it is numerous in summer on the Pamir Plateau near the source of the Syr Darya as well as the Tien Shan Mountains.

**Biology:** This is a gregarious species, generally congregating in herds of a dozen up to over a hundred individuals. These herds consist of females with their sub-adult young and immature males. Outside of the rutting season mature rams live in small bands of two or three, rarely up to five or six occurring together (De Poncins, 1895 and Mellon, 1969). These female herds live and feed at lower elevations whilst the rams remain in the higher more remote valley heads near the permanent snow line.

They confine their feeding activity to a few hours just after dawn and again become active in the evening (De Poncins, 1895 and Petocz, 1971). During the middle of the day they retreat to some higher boulder strewn ridge where they lie down and chew the cud. They have extremely keen eyesight and sense of smell and are always very wary and difficult to approach. If domestic livestock intrude upon their feeding ground they will often retreat into another valley (Petocz, 1971).

They graze mainly on the scattered bunches of coarse grass and in the summer months in some parts of the Pamirs, this grass grows almost knee high and the animals become quite fat (Carruthers, 1949). In winter they suffer from food scarcity, especially the females which feed on lower slopes and face more competition from domestic sheep and goat flocks kept by the nomadic Kirghiz. The rams remaining at higher elevations, inaccessible to such flocks, appear to keep in better condition (Petocz, 1971). Due to extreme aridity in these upland plateaus, over-grazing can easily occur. In the northern part of Hunza in winter they feed on the scattered clumps of *Astragalus* and *Allium* (wild onion), there being insufficient supply of more palatable grass species in such arid regions.

The rut is well marked and of short duration as in all wild sheep. According to recent investigations it is believed to start in the later part of September and extend into late October in the Wakhan corridor of Afghanistan (Petocz, 1971). However judging from the gestation period of other wild sheep species and other fragmentary evidence, I believe that the rut takes place later in November and even extending to early December. In the deer park of George Von Opel, the rut of Marco Polo ram occurred regularly four or five weeks after that of the Urrial kept in the same park, and it was observed in early December (Walther, 1962). It was also reported to occur in November and early December as observed by hunters in the Pamirs at the turn of the century (Lydekker, 1907). This would be corroborated by statements that the lambing season is from May and early June (Prater, 1965 and Lydekker, 1907).

At the onset of the rut the rams descend to look for oestrus ewes and join the female herds and there is then much challenging between males. Fighting, which may be accompanied by audible grunting, consists usually of backing away from each other followed by a headlong charge and both rams striking downwards with the front of their horns. The noise of such impact carries up to several hundred yards away, and the opponents are often temporarily stunned thereafter (De Poncins, 1895 and LeMB, 1900).

Fighting may however, occur at any time of the year and may also consist of two males running side by side and parallel to each other as they shove sideways into their opponent with their horns. During head on clashes rams often chip their horns or cut the skin on the bridge of their nose (Carruthers, 1949). Often rams will raise their bodies with fore-feet off the ground just before clashing together, which has not been observed in the charging of Urrial (Walther, 1962 and Schaller, 1971B). The ram tests the oestrus condition of the ewe in the usual manner of Ovidae, by approaching with extended head



and often nudging the ewe on the flank. This induces her to urinate and the ram then sniffs the ground and is apparently able thereby to judge the ewe's readiness to mate. After sniffing the urine it exhibits the curled upper lip (flehmen). Further observations on rutting and agonistic behaviour in the George Von Opel Deer Park (Walther, 1962) revealed that unlike the Urial, Marco Polo rams often stand upright on their hind legs to challenge a potential rival, following which they may or may not charge. This gesture is very rarely seen amongst Urial in the Punjab according to the observations of Dr. Schaller (1971B).

The gestation period appears to be about  $5\frac{1}{2}$  months (Lydekker, 1907 and Prater, 1965) with only a single or occasionally twin lambs being born in May and June. No information is yet available as to age at sexual maturity but probably females like Urial are bred in their second autumn when 18 months old, with only mature rams over  $4\frac{1}{2}$  or  $5\frac{1}{2}$  years of age being able to challenge dominant rams and mate with oestrus females.

Marco Polo Sheep maintain intraspecific contact by means of the pedal scent glands and their white caudal areas. When danger threatens, flocks tend to bunch together and both sexes have been observed to stamp their feet and after running some distance away to again stop and turn to face the danger. Apart from the grunting call emitted by rams in combat, lambs also call their mothers with a typically 'merrhing' call when they lose contact. No observer seems to have recorded any alarm call equivalent to the sneeze of the Urial. In the Pamirs wolves are plentiful and are the principal predator on this sheep in the winter months when they are weakened from inadequate food. Examination of the horns of many naturally killed *Ovis polii* in the Wakhan (Petocz, 1971) indicated that

mortality invariably occurred in the winter months so that with better grazing in summer they are presumed to be vigorous enough to escape wolf predation.

In one winter in the Pamirs, herds of this sheep were reported to be decimated by an epidemic of Rinderpest, no doubt introduced by domestic flocks (Lydekker, 1907). There are no exact records of the longevity of this sheep but other wild sheep species (Mouflon and Bighorns) have lived up to 15 years in captivity and there is a photograph of a 10 year old *Ovis ammon hodgsoni* killed in Ladakh (Walker, 1922), whilst an *Ovis ammon polii* shot in the Pamirs was estimated to be 13 years of age (LeMB, 1900).

### OVIS ORIENTALIS

*Ovis orientalis* Gmelin, 1774; Urial, Asiatic Mouflon or Shapu (see Illustration 61).

Subspecies *Ovis orientalis vignei* Blyth, 1841; Shapo or Shapu  
*Ovis orientalis blanfordi* Hume, 1877; Baluchistan Urial or 'Gad'

*Ovis orientalis punjabiensis* Lydekker, 1913; Salt Range Urial

**Description:** Similar to the Marco Polo Sheep in general body proportions and colouring but averaging considerably smaller in size with shorter less massive horns. The face is generally greyish, the long slender legs and belly are creamy-white and the body fur is a reddish-grey colour. There is no extensive white area in the caudal region unlike *O. ammon*. The tail is always the same colour as the dorsal hair and lacks any long hair or terminal tuft. The sub-orbital glands are deep



Illustration 61 *Ovis orientalis*: Urial or Shapu. (Based on live captive specimen 8 year old male in winter coat from Suleiman Hills, Baluchistan.)

and conspicuous often exuding a viscous substance which mats the hair. The iris is pale yellowish-grey with the retina contracting to a horizontal slot.

Adult rams develop a conspicuous chest ruff of long straight coarse hairs which starts at the angle of the jaws and terminates abruptly between the fore-legs. This ruff is predominantly white in the throat region and black as it extends down to the sternum. In summer moult this ruff is much shorter but still conspicuous. Females have slender upward curving horns about 12.7 cm (5 in.) long. The horns of mature rams are comparatively slender and angular when contrasted with other wild sheep species but they describe a very symmetrical arc when viewed from the side and curve out widely from the body, so that it is a striking looking animal especially if encountered in the first rays of the morning sun, when its coat glows an almost pinkish-red colour and the black chest ruff stands out in sharp contrast. Older rams also develop traces of a greyish-white saddle mark in the winter coat.

Rams stand up to 76.15 cm (30 in.) at the shoulder with the northern Himalayan population averaging bigger and mature males of *O. orientalis vignei* up to 91.5 cm (36 in.) at the shoulder. Females stand about 68 cm (27 in.) high at the shoulder. The rams bear horns having a basal circumference of 25.5–31 cm (10–12½ in.) and length measured along the outer curve of 63.5–73.6 cm (25–29 in.). The record horn length from the Punjab (Kala Chitta Hills) is 96.5 cm (38 in.) and from Baluchistan (Zhob, Waziristan border) 105.5 cm (41½ in.) whilst the record horn length from the northern Himalayas is 99.1 cm (39 in.) (Stockley, 1928 and Biggs, 1913). A Gilgit head is on record having horns 91.5 cm (36 in.) (Ward, 1923A).

### Subspecies

*O. orientalis vignei*: Its body fur tends to be more greyish in winter and less red. The chest ruff is comparatively short with black hairs predominating, and as noted above they average larger in size than the Punjab and Baluchistan populations. The horns turn markedly inwards at their tips and often the wrinkles or corrugations are rather shallow and indistinct.

*O. orientalis blanfordi*: The Baluchistan population tends to have a longer more luxuriantly developed neck ruff (a captive male when adult had hairs measuring up to 20 cm (7¾ in.) in the chest region). The body fur is reddish and the saddle mark in males is generally very indistinct or lacking (Roberts, 1967). The rams have horns which often develop more than a complete arc when viewed from the side with the tips bending slightly outwards.

*O. orientalis punjabiensis*: The Punjab Urial often has horns which are more massive at their base than the Baluchistan population but these never curve round in more than a complete arc. Often males tend to be smaller and stockier in build than the Baluchistan subspecies and mature rams develop a conspicuous saddle mark in the form of a vertical band of mixed black and white hairs (Roberts, 1967).

**Distribution and Status:** In Baluchistan and Waziristan, the Urial inhabits the gentler slopes of the higher mountain ranges and will occur up to 2750 m (9000 ft) in association with scattered *Juniperus macropoda* forest in northern Baluchistan. In Kalat, the Mekran coast range and Sind they are found in hills (up to 2500 ft), with stunted *Acacia senegal* trees and Dwarf Palm (*Nannorrhops ritchieana*).

In the Salt Range and the southern North West Frontier Province ranges they are typically associated with lower rounded stony hills dotted with wild Olive (*Olea cuspidata*) and *Acacia modesta*. In Waziristan and the lower Himalayan

ranges as well as the Khyber and Malakand agencies and Chitral they are associated with holly oak (*Quercus baloot*). In the extreme northern and inner Himalayan ranges, the Shapu is associated with barren treeless regions occurring in stony valleys and lower foothills. They avoid steep precipitous regions in all cases and are usually found in regions with deep erosion gullies interspersed with relatively smooth boulder-strewn slopes. All these are arid mountain steppe regions.

The Urial is widely distributed throughout most of the higher hill ranges of Baluchistan as well as Las Belas and Sind Kohistan. About 32 still survive in the Mari Manghtar Hills 38 miles north of Karachi as well as small numbers in the Pab and Kirthar hill ranges further to the west and north. Their numbers have declined considerably in Sind Kohistan due to hunting pressure, according to reports from the Forestry Department (W. A. Kermani, Secretary Wildlife and Forests, 1971, pers. comm.). They are believed to be fairly numerous still in the Hinglaj hills of the Mekran (Syed Asad Ali, pers. comm.). Wild sheep still survive around Turbat and Ormara in the Mekran coast hills. Small numbers survive in the Gishk hills (north eastern Kalat) (G. B. Schaller, pers. comm.) as well as Zambaza range 30 miles south of Fort Sandeman (Islam Khan, D. F. O., Loralai) and Daman Ghar range north east of Hindu Bagh (G. B. Schaller, pers. comm., 1973). They have been almost exterminated from the Chiltan Hills near Quetta (Z. B. Mirza, pers. comm., 1970). Larger numbers still survive on the Takhatu range north of Quetta. There are still Urial in the remoter hill ranges of Waziristan bordering Afghanistan (Major S. A. Khan, pers. comm.). In virtually all other hill regions of the North West Frontier Province where they used to be common (Warburton, 1970 and Malak Asad Khan, pers. comm.) they have been exterminated by excessive hunting. In Chitral on the right or west bank of the Kunhar river, where they used to be plentiful, they have also become extremely rare within the past decade (Shahzada Prince Burhan-ud-Din, pers. comm., 1967). The same is the position in the lower hills surrounding Gilgit valley. Nothing is known of the status of the Shapu population which still survives in north eastern Baluchistan and Baltistan, near the Chinese Turkestan border but it is presumed that they are not subject to severe hunting pressure as were the populations surrounding Gilgit and Chitral main valleys.

In the Salt Range they have been totally exterminated from the Khair-i-Murat Hills but a few still survive around Traki north of Jhelum as well as around Bhoun and West of Chakri in the Salt Range. The main concentrations now are in the Kala Chitta Hills in the north west and the Masan Valley or Kala Bagh area which latter has been made into a World Wildlife Fund Reserve (Mountfort, 1969) and now contains the biggest concentration of the Punjab subspecies, estimated to number nearly 500 (Schaller, 1971A).

It would appear as though the Chitral and Gilgit populations will shortly become extinct. From captive specimens seen by me, they appear identical to the Salt Range subspecies and the much larger Shapu is probably a separate population confined to Northern Hunza. In 1963 there were four heads of this subspecies (*O. orientalis vignei*) collected by the Pakistan Chinese Boundary Commission with a Rawalpindi taxidermist. Though claimed to be *O. ammon polii* these were in fact Shapu with marked throat ruffs and had been shot near the Chinese Turkestan frontier. The Baluchistan population seems to have been able to hold its own in the remoter mountain ranges and does not appear immediately endangered. The Punjab subspecies is now also safe, provided the comparatively concentrated Kala Bagh population does not become decimated by disease. (See Distribution Map 76.)



**Biology:** Like the Marco Polo Sheep, Urial are gregarious and the biggest herds consist of associations of females with their followers and immature males. The rams keep in small separate groups outside of the rutting season and may even congregate in quite large flocks where the population is dense. In the preserved area of Masan Valley in Mianwali district I have seen a herd of mature rams numbering over 40 individuals on 9 March. Dr. Schaller observed a male herd in the same region numbering 30 rams in early October (Schaller, 1971B) before the rut commenced.

Feeding activity is confined to the early morning and evening in the summer months, often commencing well before dawn. Their preferred food is grasses which grow in scattered clumps and in the Salt Range *Tetrapogon villosa* is believed to be a favoured species, and is known to local people by the vernacular 'oorial garh'. The preferred species as noted in Schaller's (1971B) study of Salt Range Urial were however, *Eleusine flagellifera*, *Digitaria bicornis* and *Cenchrus pennisetiformis*. They will, in times of fodder scarcity, browse the leaves of both *Acacia senegal* and *Acacia modesta*, and I once observed a ewe apparently eating the pink mucilaginous fruits of *Capparis aphylla* which also grow in the Baluchistan lower hills as well as in the Salt Range.

During the day they rest, usually in the shelter of a ravine and often under an overhanging bush or rock where they are well concealed. Their sight, hearing and sense of smell are all acutely developed. They are excessively wary, depending upon early detection of approaching danger and flight for their survival. Both sexes will give a warning of danger especially if not imminent or its source not located, by emitting an explosive sneeze call which carries for several hundred yards. During the rut a captive male often emitted a low guttural 'Murrh' call (Roberts, 1967) and lambs when they lose contact with their mothers also bleat. Females often stop, turn round to face the intruder, and stamp their fore-feet after fleeing a short distance from danger.

In the Salt Range the rut has been well studied and commences from about mid October lasting until late November (Schaller, 1971B). In southern Baluchistan and Sind the rut may commence about eight to ten days earlier than this. There is much challenging between adult rams during the rut and fights occur in which the two adversaries back off and repeatedly charge each other with frontal clashes of the horns. Such bouts may last up to several seconds the adversaries backing away 6–9m (20–30ft) each time. (Schaller, 1971B). They do not rear up before charging as *Ovis ammon polii* was observed to do. But often on the moment of impact they have their hind legs stretched out clear of the ground. I have only once witnessed such a fight and though it was at over 400yd distance, the sound of impact of their horns was like a pistol shot. Besides such actual clashes males often challenge each other with ritualized gestures and establish dominance by such threats. In one threat display they jerk their horns downwards and sideways towards an opponent; in another commonly observed display, by lowering the head and rotating the neck 90° so that the horns are turned away from the threatened partner. This twisting gesture is often accompanied by extension of the tongue (Schaller, op. cit.). The most commonly used display gesture however is the stiffly raised fore-leg which is directed as in a kick towards the opponent. Both males and females will use this mildly challenging kick gesture which was termed 'laufs Schlag' in the pioneering studies of F.

Walther. It is noteworthy that feral Soay sheep in the Outer Hebrides also exhibit this laufs Schlag gesture during the rut (Grubb, 1970). Rutting Urial rams seem to travel continuously around searching for oestrus females — often in small groups of several rams together (Schaller, pers. comm.). This is in marked contrast to Wild Goats which tend to attach themselves to a particular group of females and to remain in a particular territory during the rut.

The gestation period appears to be about 160 to 164 days but may be shorter as definite evidence is lacking (Stockley, 1922). A captive female in my possession was apparently oestrus on 25 November and was definitely mounted by the ram on the night of 25/26 November, but she produced a single lamb on 10 April after an interval of only 134 days. This female was sexually mature at 18 months of age, being exactly 2 years old when its first lamb was born. Rams show no sign of sexual interest or rut until their third autumn when they are 2½ years of age, but observations on wild herds indicate that only the dominant rams of 4½ years or older are able to mate with oestrus ewes, the younger males being driven off (Schaller, pers. comm.). As in the case of other wild sheep the male nudges the ewe and induces her to urinate in order to test her oestrus condition.

Lambs are born in mid April to early May in the Punjab and often as early as late March in the Kirthar range in Sind. A newly-born ram lamb in my possession was observed to jump right over its mother's back when it encountered its first human, at a time when it was estimated to be only four to five hours old. They are therefore remarkably quick to gain strength and become active. They are weaned at about five months of age but lambs of six and seven months can be observed occasionally trying to suckle. They continue to show close attachment to the mother until the following spring and up to the age of 10 or 11 months often lie down to rest in physical contact with the mother. A captive male when separated at 12 months from its mother still became very agitated in its efforts to rejoin her. Twin lambs are occasionally born and this probably depends on the availability of fodder during the rutting season. According to my observations twins seem to be much less common than is the case with wild goat species.

Urial are much persecuted by local hill people who hunt them for their meat and as they inhabit relatively accessible lower hills they have been exterminated in many former parts of their range during this century. Wolves, Leopards (Stockley, 1936) and Caracal Cats (H. W. Waite, pers. comm., 1965) have all been observed as preying on Urial. In the Punjab Salt Range the Leopard and Caracal are now very rare and human predation is probably the only significant factor, plus competition from domestic grazing flocks.

A captive male in my possession died at ten years and six months of age apparently from general debilitation but there are records of other captive specimens living over 11 years (Dover, 1933). Horn growth is comparatively rapid in the first three or four years of life and a captive male attained 30in. horn length by its fourth year (Roberts, 1967), which is contrary to what Colonel Stockley has written (Stockley, 1936). The same specimen as measured from annular rings continued horn growth though in decreasing amounts after its fifth year, but it was noticed that the horn tip wore down roughly to an equivalent amount so that the total length as measured along the outer curve hardly increased beyond 30in.

# 11 LAGOMORPHA

The order comprises two families. *Leporidae* which includes over fifty species of hares and rabbits and *Ochotonidae* which includes about fourteen species of pikas or mouse-hares. In many respects closely similar to the Order *Rodentia*, they were until recently included as a sub-order *Duplicidentata* within the Order of Rodents.

They are distinguished, however, in having two pairs of incisors in the upper jaw. Actually at the time of birth they have three pairs of which the outer is almost immediately shed, and the second pair remains very small and non-functional. This second pair is situated immediately behind the first pair of incisors (see Fig. 57).

*Lagomorpha* are purely herbivorous and like the rodents their incisors grow throughout life so that they are highly adapted to cope with a fibrous diet. Unlike the rodents they have an extensive caecum which aids in bacterial digestion of their diet.

Recent studies of their blood physiology indicates that the *Lagomorpha* may be more closely related phylogenetically to the hooved animals (ungulates) than the Rodents (Walker et al., 1964). The distance between their mandibular and maxillary cheek teeth is such that only one pair of rows can come into contact simultaneously, the mandibular tooth rows being closer together and the maxillary rows wider apart. Grinding of food must be performed by lateral movements of the lower jaw, a similar action to that of ungulates. Most rodents have both pairs of tooth rows simultaneously opposable and masticate food with oblique or longitudinal jaw movements. No *Lagomorpha* use their fore-paws to convey food to their mouth in contrast to the majority of rodents.

## Key to the Order LAGOMORPHA

Having two pairs of incisors with only the front pair functional. Cheek teeth adapted for grinding fibrous food and separated by a wide diastema from incisors. Three pairs upper pre-molars and two pairs of lower pre-molars. Tail very short and tufted or entirely absent.

## FAMILY LEPORIDAE – HARES AND RABBITS

Comprising nine genera and about fifty species (Walker et al., 1964), hares and rabbits occur throughout almost the whole world, except the Antarctic region and Australasia. As is well known, the rabbit (*Oryctolagus cuniculus*) has been introduced into Australia with devastating consequences. They have five digits on the fore-foot and usually four on the hind foot. Males have no baculum (*os penis*). Hares, in contrast to rabbits are not fossorial and their young are born fully furred with eyes open and physically active. The upper lip is characteristically split. Females have three to five pairs of mammae and are usually larger in size than the males, a condition not found in most other mammalian orders.

## Key to the Family Leporidae

Having elongated hind limbs with the soles of both fore and hind feet entirely covered with hairs, including digital pads. Ears very long and narrow. Tail short (under one-seventh of head and body length) and fluffy throughout its length.

## Genus LEPUS Linnaeus, 1758

This genus includes the hares, comprising 26 species. They occur throughout Africa, North America and most of Eurasia extending up to the Arctic. Most species have greatly elongated hind legs and inhabit open grassy areas. All have feet well furred and do not dig burrows.

## Key to the Genus LEPUS

Two pairs of upper incisors. A wide diastema. Constriction of the palate to a narrow bridge giving the skull a typical Lagomorph aspect (see Fig. 57). Ear very long and broad.

## Key to the Pakistan Species of LEPUS

- (a) Dorsal surface of tail dark brown. Pelage tone ochraceous.  
... *Lepus nigricollis dayanus*
- (b) Dorsal surface of tail black. Pelage tone greyish-buff. Tympanic bullae generally less than 15 per cent of occipito-nasal length.  
... *Lepus capensis*
- (c) Dorsal surface of tail black. Size smaller than other local hares. Tympanic bullae 16 per cent of occipito-nasal length.  
... *Lepus arabis*

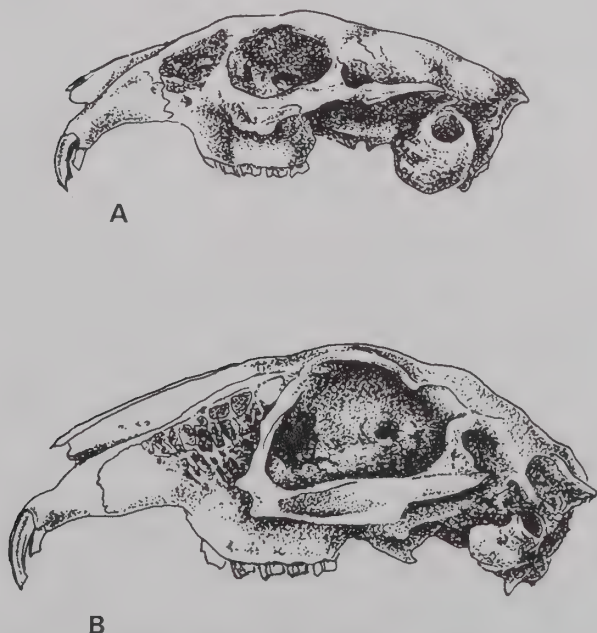


Fig. 57 Showing lateral view skulls of *Lagomorpha*.  
A. *Ochotona roylei*.  
B. *Lepus nigricollis dayanus*.  
Note non-functional, peg-like second incisor and wide diastema between cheek teeth and incisors.



**Taxonomy:** Ellerman and Morrison-Scott (1951) gave considerable attention to the revision of named species from Palearctica and the Indo-Pakistan subcontinent, recognizing the confused state of taxonomy of the group. They recognize three species as occurring in the region and these three species are included in Siddiqi's published checklists for Pakistan (1961 and 1970). Recent research has shown that *L. capensis* and *L. europaeus* are conspecific and probably *L. arabis* is merely a race of *L. capensis*, (Cabon Raczynaska, 1964 and Petter, 1961B). Even the Indian endemic species *L. nigricollis* was considered as belonging to the *L. europaeus* group by Ellerman and Morrison-Scott (1951). Studies of the considerable material now available from the Middle Eastern countries indicate that *L. capensis* is a highly polymorphic species which in northern regions merges clinally into *L. europaeus* and in the southern desert regions into *L. arabis* (Lay, 1967 and D. L. Harrison, 1972).

### LEPUS NIGRICOLLIS

*Lepus nigricollis* Cuvier, 1832; Indian Hare or Black-naped Hare.

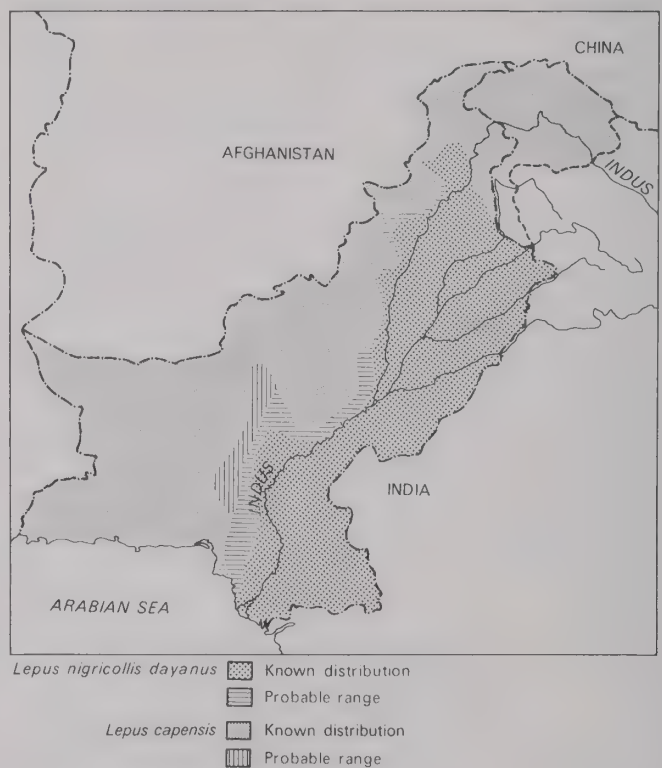
Subspecies *Lepus nigricollis dayanus* Blanford, 1874; Desert Hare.

**Description:** In the dry north west part of the Indo-Pakistan sub-continent the subspecies *L. nigricollis dayanus* occurs. This is a smaller hare on average than the nominate race, being of a paler sandy-buff colouration, lacking the rufescent tinges of the nominate subspecies and particularly having no trace of a collar of black hairs in the region of the lower neck which gives rise to the specific name *nigricollis*.

The Desert Hare is a slender-limbed animal with very long broad ears and greatly developed long hind legs. The fur which is relatively short and harsh is banded with pale cream and black, giving it a speckled or pepper and salt appearance when viewed close up. The general effect is a warm buff colour with the hair on the lower limbs being more ochraceous. There is also an orbicular ring of paler hairs and the broad ears are covered with short buff hairs being practically naked on their anterior surface. Compared with both the Pakistan population of the Cape Hare (*L. capensis*) and the European Hare (*L. europaeus*) the tips of the ears have a much less conspicuous black border which may be practically absent. The very broad ears are folded inwards on their anterior margin and in bright sunlight are semi-translucent so that it is even possible to see the circulation of blood in the small capillaries of the ear. Such large ears are a valuable ecological adaptation in this non-burrowing desert dwelling species as they act as radiating surfaces for heat loss (see Chapter 3). The Desert Hare like all hare species has eyes placed very high up and far back in the skull. Their lateral position gives them a wide angle of monocular vision and they can see approaching enemies from above and behind without turning their heads. But they have relatively poor vision for an object approaching them from directly in front (Lancum, 1951). The iris is walnut brown in colour. The upper lip is split and the incisors are covered with white enamel. The short tail covered with soft long pure white hairs has a narrow band of reddish-brown and mixed black hairs on its dorsal surface and this feature is diagnostic in separating the Desert Hare from the Cape Hare which has the back of the tail wholly black. The male has a sac-like gland surrounding the anus. The belly fur is long, soft and creamy-yellow in the chest and throat region being whiter in the lower belly and inguinal region. The hair on the nape of the neck is generally of a warm buff colour and par-

ticularly soft and short. There are strong claws on both fore and hind feet. Five typical adult specimens from the Punjab had the head and body length averaging 480mm (range 330–528mm) with the tail averaging 77mm (range 64–90mm). The hind foot averages 102mm (range 86–113mm) and is generally a bit shorter than the ear. The longest vibrissae are black in their proximal region but white tipped and measure up to 90mm (3½ in.) in length.

**Distribution and Status:** The Desert Hare is highly mobile and adaptable so that it can be found in crop land throughout the Indus basin as well as in extensive sand-hill desert and ascending into low rocky hills in regions west of the Indus as well as scrub forest in regions such as the Salt Range or Kala Chitta Hills.



Distribution Map 77 Desert Hare.  
Cape Hare.

It does not, however, find permanent shelter in crop land, but prefers waste land on the borders of cultivation and its preferred habitat is in the uncultivated tracts of the riverine zones where there are extensive clumps of *Saccharum munja* grass. It readily adapts to irrigated forest plantations.

It occurs throughout Sind, Las Belas, the Sibi Plain, Bahawalpur Division and the Punjab. It also occurs in the desert regions of Cholistan, Thal and the Thar. In the North West Frontier Province it extends through the Vale of Peshawar and the lower part of the Kurram Valley. It also occurs in Dera Ismail Khan and Dera Ghazi Khan districts.

Except for the remoter tracts of the Salt Range and the eastern border deserts, there is sufficient evidence that the Desert Hare has declined considerably in the past two decades. This is mainly the result of a continuous decrease in the areas of scrub jungle and particularly the uncultivated riverain tracts which were its principal habitat. The control of flooding of the Indus River and its tributaries as a result

of barrages and irrigation schemes has made possible more extensive cultivation right up to the river banks.

Besides reduced habitat the hare has suffered increased hunting pressure. This animal has traditionally been favoured for hunting sport, though many Muslims consider them unclean feeders and will not eat them. In Mianwali District they are still coursed on horseback around the Indus river. In other parts of the Punjab and particularly in the Salt Range they are hunted with Goshawks (*Accipiter gentilis*). In Multan District of the Punjab they are regularly hunted with greyhounds. In Sind hares used to be successfully hunted by certain local tribes, killing them with a throwing stick. In the late 1940s in Sanghar District I remember seeing a hare successfully knocked over by this method at about 20 paces though it was in full gallop. Hunting with shotguns has to a large extent replaced many of these traditional forms of hunting.

The Desert Hare is nowhere numerous enough to inflict significant damage to agricultural crops and because of their ability to survive in the uncultivated desert regions they will no doubt continue to hold their own in the border areas, but at a much lower population density than for example the European Hare in many well settled agricultural districts of Britain.

**Biology:** The Desert Hare is a non-social species living a solitary existence outside of the breeding season within a fairly well defined territory. They do not excavate burrows or normally shelter in the holes excavated by other animals except when pursued by some predator. Dr. Taber, however, trapped an immature individual in the mouth of a porcupine (*Hystrix indica*) burrow and often observed tracks of hares which led him to suppose that hares rested in other animals' burrows even when not disturbed (Taber et al., 1967). There are many records of this hare entering the burrows of other animals when being pursued by dogs (Finn, 1929). Normally it rests by day in a slightly hollowed nest or 'form' in a clump of grass or under a bush. In the Salt Range they will often lie in a shallow scrape in the soil protected by an overhanging stone or rock. Usually they emerge to feed just before dusk and are most active in the early hours of the night, resuming another spell of feeding just before dawn. The Desert Hare grazes on grass-shoots when these are available but will eat all kinds of forbes as well as the young leaves of trees and even the bark from twigs and younger branches.

Despite being a shy and timid creature, which relies upon instant flight to escape predators, hares exhibit a remarkable degree of intraspecific aggression. No doubt this is necessary in a species whose survival depends upon living in widely spaced territories. The author soon learned in trying to keep captive specimens that even males and females cannot be kept together in a relatively confined enclosure without fighting. The normal method of attack is by leaping up and giving vigorous kicks on the opponent with the hind legs. Such kicks are remarkably powerful and have even been known to put to flight some of the smaller carnivora. Probably in the wild state there is very little contact between individuals as they leave a strong scent from the anal gland where they lie up.

During the rut the males roam more widely and fights then occur, both animals rearing up on their hind legs and striking with their fore-paws as well as trying to bite. Studies in Rajasthan by Prakash and Taneja (1969) indicate that males were found to be in reproductive condition throughout the year but the females produce young only during the spring and summer months with the majority of litters being

produced at two peak seasons, in the early spring and again at the beginning of the monsoon. These periods coincide with a more abundant supply of new vegetative growth. The gestation period seems to vary from 42 to 44 days and this duration has also been observed for *L. europaeus* in captivity (Hediger, 1964). In the Punjab, the main rutting season seems to be in the second half of February. Several litters in the south west Punjab have been discovered in late March and early April consisting of two young in all cases. I. Prakash (1969) found that the average litter size in Rajasthan was 1.84 and litters varied from 1 to 4. The newly-born young which are well covered with fur and active, have relatively short ears with a comparatively large round head. They are extremely attractive baby animals to look at. Very little has actually been recorded about the breeding habits of this species or indeed any hare under natural conditions. The baby hares instinctively remain lying quietly in the 'form' where the mother leaves them. Presumably the mother recognizes them by scent and the babies are in no way imprinted upon the mother, neither do they make any attempt to follow her. This supposition is corroborated by the fact that if a human being handles a baby hare the mother will refuse to recognize or suckle its offspring presumably because of the human scent. It is not known at what age the young hares can forage for themselves or how quickly they are weaned.

Probably most females produce two litters in a year and observations of *L. europaeus* in captivity indicate that females come into oestrus immediately after giving birth to young and are normally mated at this time (Hediger, 1964). Suprafoetation apparently regularly occurs with *L. europaeus* and may well be a common phenomenon in the Desert Hare. This means that the pregnant female allows herself to be mated three or four days before parturition. It has been shown under captive conditions that such a female not only bears a normal litter after three or four days but produces a second litter after a period of 39 days (Hediger, op. cit.). This may be connected with the fact that a foetus only develops in one horn of the uterus in the initial pregnancy.

There is no evidence of hares breeding in the winter months in Pakistan though Prater (1965) in reference to the nominate subspecies in India, states that the breeding season is from October to February. Taber (1967) also found pregnant and lactating females around Lyallpur between October and February but gives no precise dates and it is probable that the lactating females were collected in October and November and the pregnant animals in February. The European Hare is not sexually mature until two years of age (Walker et al., 1964). There is no evidence as to the age of sexual maturity of the Desert Hare. A captive European Hare (*L. europaeus*) has survived for nearly 12 years (Crandall, 1964).

Hares are vulnerable to a number of predators because they do not shelter in underground burrows and are comparatively large in size. Their survival in the barren open country which they inhabit has been largely due to their extreme timidity and alertness. They have acute hearing and a well developed sense of smell and sight. Their large ears can be independently rotated through an angle of  $270^\circ$  and when a hare cautiously emerges to feed in the evening it can be seen testing the surroundings for any hint of danger both by sniffing and rotating its ears. They will also sit up on their hind legs from time to time as though to get a better view of the surrounding terrain. As is well known, from hunting with dogs, a hare lying in its 'form' gives off very little scent and they instinctively remain motionless even when they have observed approaching danger, if they think they can escape detection. Only when the potential enemy approaches within



a certain distance do they burst forth from their layer with prodigious zig-zagging leaps. They are capable of outrunning most predators at this stage, though there is an authentic account of an Indian wolf coursing and catching a Desert Hare (Lester, 1896) and I have encountered an obviously frightened and exhausted hare in the Soon Valley of the Salt Range which was being closely pursued by a fox (*V. vulpes pusilla*). They will often run straight down a roadway if caught in the headlights of a vehicle and I have clocked this species running along a forest roadway at night when it maintained a speed of at least 54km/hr (33 mile/hr) over a distance of about 200m (220yd), an astonishing burst of speed for such a small animal. Besides wolves (*Canis lupus*) and foxes (*V. vulpes pusilla*) they are preyed upon by wild cats (*Felis chaus* and *Felis libyca*). I have watched a pair of Jungle Cats (*Felis chaus*) stalking a Desert Hare at dusk. They are probably attacked at night by the Eagle Owl (*Bubo bubo*) and I once witnessed the dramatic sight of a Bonelli's Eagle (*Nisaetus fasciatus*) successfully capturing a hare which had been accidentally put to flight by humans in the middle of the morning. They are probably safe from most diurnal birds of prey as long as they remain concealed in grass thickets. Man, of course, is also a relentless hunter of this hare.

#### LEPUS CAPENSIS

*Lepus capensis* Linnaeus, 1758; Cape Hare (see Illustration 62). Now considered conspecific with *Lepus europaeus* (Petter, 1961).

Subspecies *Lepus capensis tibetanus* Waterhouse, 1841

**Description:** In Pakistan this hare is similar in appearance to *Lepus nigricollis dayanus* sharing the same very broad ears and comparatively smaller size and lighter build than the *L. europaeus* population of western Europe.

It differs from the Desert Hare in having a much longer and softer pelage with a thick blue-grey underwool during the winter. Though the longer guard hairs are banded with black and buff the general tones are much greyer than in *L. nigricollis dayanus*. Also there is a fairly distinctive black margin to the tips of the ears and the back of the tail is pure black without any brownish tone which feature also serves to distinguish *L. nigricollis dayanus*. Twelve specimens from Baluchistan and Waziristan had the following dimensions: head and body length averaging 413mm (range 395–495mm), with the tail averaging 85mm (range 70–111mm), the hind feet averaging 120mm (range 115–129mm) and the ear averaging 120.8mm (range 116–130mm). An adult male from Wam had ears measuring 120mm in length and 160mm broad at their widest point. Other features are the same as in the Desert Hare. The soles of the fore-feet are thickly covered with hair and there are powerful claws on fore and hind feet which must assist the animal in digging for bulbs and rhizomes. There is a ring of paler creamy hairs around the eye and usually the centre part of the forehead has more mixture of black hairs. The belly fur is comparatively longer and pure white. The incisors are coated with white enamel.

Specimens from the extreme northern part of Gilgit and Chitral are more blue-grey in colouring and average slightly larger in size than specimens from Baluchistan.

**Distribution and Status:** It is associated with semi-arid mountain steppe regions over most of Pakistan and is typically found in Baluchistan in *Artemisia scoparia* steppe and in Chitral and Gilgit in *Artemisia maritima* steppe (see Distribution Map 77). In the Himalayan foothill regions it does descend as far as tropical pine forest and in the northern Himalayan regions it ascends to alpine meadows in the summer months up to 4250m (14,000ft) in elevation. It can

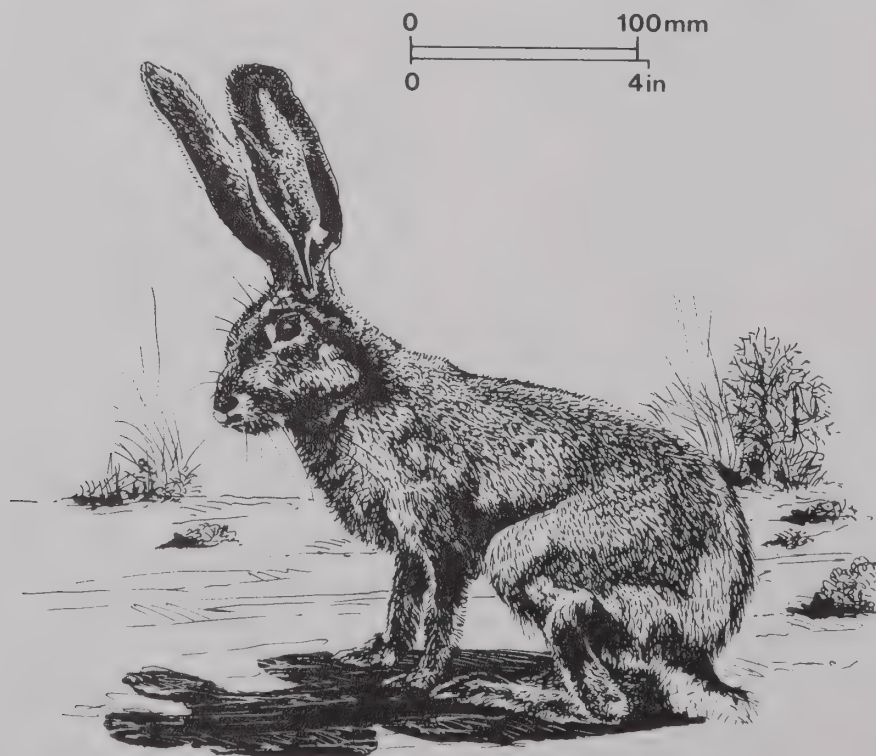


Illustration 62 *Lepus capensis*: Baluchistan or Cape Hare.  
(Based on live captive adult male specimen from Wam, north east Baluchistan.)

however be found as low as 600m (2000ft) in southern Baluchistan in broad stony open valleys. It is absent from the Indus riverine plain.

The Cape Hare occurs throughout Baluchistan from Panjgur in the south, through Kalat, Chaman, Loralai and Zhob up to Fort Sandeman. It occurs throughout the mountainous regions of Waziristan as well as the upper Kurram Valley, Malakand, Swat, Dir Chitral and Gilgit. It has been collected at Tret in the Murree Hills at 900m (3000ft) by the author and near Muzaffarabad in Azad Kashmir at 600m (2000ft) elevation by Z. B. Mirza (Mirza, 1965B).

Extra-limitally it occurs throughout Iran, the mountain steppe regions of Baluchistan and in southern Asiatic Russia.

In contrast to *L. europaeus* which has at times been quite highly valued by the fur trade, *Lepus capensis* is rarely hunted for its pelt. The skin is in fact, unusually soft and tender so that it is difficult to avoid damage in removing the pelt. If a captive animal is handled at all roughly the skin ruptures and fighting hares can readily inflict wounds on each other because of their delicate skin. Perhaps this factor has contributed to the continued survival of hares in these mountainous regions where all mammals are hunted ruthlessly if they have any economic value. There has probably been no great change in the status of this hare in Pakistan in the last few decades because it is so thinly and widely distributed in such remote regions.

**Biology:** The habits of this species are broadly the same as *L. nigricollis dayanus* in that it is non-social, largely crepuscular in activity and lives within relatively distinct defined territories. Besides feeding upon grasses when available they will eat the leaves of artemisia and salvia shrubs which scatter the mountain slopes in these arid mountainous regions. They probably supplement their diet in winter by digging up various bulbs such as *Eremerus* species and *Tulipa* spp. Observations on a young male captive specimen which I was able to keep for nearly two years showed that it practised coprophagy like *L. europaeus*. Large sized blackish faecal pellets produced mostly during the night were consumed in the early morning and the daytime faecal pellets were of a much greener colour and smaller. In the northern regions of the Himalayas there is evidence of some seasonal altitudinal migration as they will ascend to the alpine meadows during the summer months and in winter frequent the valley bottoms where there is generally less snow or often none at all. They rest by day under the shelter of some bush or over-hanging stone and do not excavate their own burrows. *Lepus tibetanus* which inhabits the Pamir mountains on the northern borders of Chitral and which is here considered as conspecific with *Lepus capensis tibetanus* also exhibits this seasonal altitudinal migration (Ognev, 1940).

It is probable that the Cape Hare is capable of producing two litters a year in most parts of Pakistan though little has been recorded about its breeding. In the higher mountain regions of north eastern Baluchistan, baby hares have been found from early April to the beginning of May. In the Murree foothills at an elevation of about 900m (3000ft) two babies were found in late August at which time they were approximately a week to 10 days old and this would seem to indicate the capability of producing two litters in a year. The females have 6–8 mammae like *L. nigricollis* and the newly born hares have their eyes open and are capable of quite active movement after they are about 12 hours old.

The Cape Hare is much preyed upon by Hill Foxes (*V. vulpes griffithi*). It is possible that they also provide an impor-

tant food species for the Himalayan Lynx (*Felix lynx*) in the northern Himalayas, as they tend to be more numerous in such regions of Chitral and Gilgit where *Felix lynx* also occurs. Cape Hares no doubt suffer predation from Golden Eagles (*Aquila chrysaetos*) in Gilgit and Booted Eagles (*Hieraaetus pennatus*) in Baluchistan. In the Kirthar Hills I have seen a Bonelli's Eagle (*Nisaetus fasciatus*) carrying a dead Cape Hare, but this eagle is not particularly common in the higher mountain ranges.

## LEPUS ARABICUS

*Lepus arabis* Ehrenberg, 1833; Arabian Hare.

Synonym *Lepus craspedotis* Blanford, 1875.

Hares collected in Baluchistan were described as a new species *L. craspedotis* by Edward Blyth in 1875. Subsequently *L. craspedotis* was considered only as a subspecies of *L. arabis*, being distinguished from *L. capensis* by its relatively paler colouration, smaller size and inflated tympanic bullae.

As far as Pakistan region is concerned, examination of all available material in the Bombay Natural History Society and British Museum collections reveals that specimens assigned to *L. arabis* have been collected from all parts of Baluchistan and south Waziristan so that it is entirely sympatric with *L. capensis*. Contrary to the key given by Z. B. Mirza (1970) the dorsal surface of the tail is black not brown, and in all external characters plus body measurements it cannot be separated from *L. capensis*. There is insufficient skull material from these Baluchistan specimens to enable any useful comparisons to be made between the relative size of the tympanic bullae. Until more evidence is forthcoming, therefore, there does not seem to be any valid reason for retaining even *L. capensis arabis* as a distinct subspecies occurring in the mountainous regions of Baluchistan and south Waziristan.

## FAMILY OCHOTONIDAE

Containing a single genus with 12 species in Asia associated usually with rocky areas in boreal forest or mountainous regions. Two species also occur in North America in mountainous regions. All pikas are diurnal and gregarious.

### Genus OCHOTONA Link, 1795

Head and body 130–250mm. Ears roughly circular in outline. Hind feet not greatly elongated or strongly developed and with digital pads exposed in summer. Without any tail.

### Key to the Pakistan Species of OCHOTONA

- (a) General body colour rufous-sandy with paler buff nuchal collar. Distal pads on hind feet naked and black.  
... *Ochotona rufescens*
- (b) General body colour darker cinnamon with no distinct paler nuchal colour. Digital pads of hind feet concealed by hair in winter. Ears under 27mm.  
... *Ochotona roylei*
- (c) As in (b) but with ears over 27mm.  
... *Ochotona macrotis*



**OCHOTONA RUFESCENS**

*Ochotona rufescens* Gray, 1842; Afghan Pika or Collared Pika. Russian name — Reddish Pika (see Illustration 63).

**Description:** All three species of Pika, which have been recorded from Pakistan territory, are closely similar in external appearance and size. The Afghan or Collared Pika is about the size of a guinea pig or slightly smaller and lacks any trace of tail like the former animal. However, the Pika has quite conspicuous upstanding ears which are almost circular in outline. Unlike the *Leporidae*, its iris is black and the eye is comparatively smaller in size.

The Pika has long white vibrissae and the upper incisors bear a prominent longitudinal groove on their anterior surface (see Fig. 58). The lower incisors are ungrooved. Both pairs are covered with white enamel. There is a second pair of small peg shaped incisors situated immediately behind the central pair (see Fig. 57).

The hind foot is slightly elongated and the animal is plantigrade but this limb is not greatly enlarged. There are four toes on the hind feet, and five on the fore-feet, armed with strong sharp black claws. The fore-legs appear very short and in fact are partly concealed within the loose skin of the body. The soles of the feet are thickly covered with hair except for small naked black digital pads which in this species are visible both in summer and winter (see Fig. 58).

As in the other pika species, the Collared Pika has very soft silky fur with dark blue-grey underfur. The general colouration is pale reddish-sandy, paler than the Himalayan species. The distinctive feature of this pika and from which it derives its name, is the presence of a paler sandy-buff collar of hairs just in front of the shoulders usually bordered posteriorly in adult specimens by darker cinnamon-red hairs. Older males appear to have more reddish-brown tipped guard hairs particularly in the dorsal and lower flank regions. Young animals are a more greyish-buff colour. The belly fur is more uniformly coloured and a paler creamy-buff. This species has comparatively smaller ears than the Himalayan species. Dimensions of eight specimens from Baluchistan

were as follows: Head and body length averaging 196mm (range 170–225mm) with the hind foot averaging 35mm (range 32–37mm) and the ear averaging 23mm in length (range 20–25mm). An adult male weighed 230g (8oz). There is no tail.

The female has four pairs of mammae. The male lacks any baculum. The testes are situated anteriorly to the penis in a scrotum but outside of the breeding season they become inguinal.

**Distribution and Status:** This pika is associated with mountain steppe forest normally at elevations above 1200m (4000ft) and even up to 3600m (12,000ft) at the very summit of mountain ranges. It will occur in *Juniperus macropoda* forest as well as on the edge of patches of cultivation in the higher remoter valleys and particularly favours stone walls and embankments surrounding such cultivated areas. It also inhabits comparatively arid mountain slopes where steppe forest no longer exists such as in the Chiltan and Bolan. The Collared Pika has not been recorded from the extreme southern part of Baluchistan or anywhere in the Mekran. The southernmost limit of its range is probably in the Gishk Hills of Kalat where it occurs very sparingly. It is more plentiful in the Koh-i-Maran Range and the Chiltan Hills. It occurs in the Bolan Pass right down to about 900m (3000ft). It extends throughout the higher mountain ranges of central and northern Baluchistan including Ziarat and Fort Sandeman. It occurs in the higher mountain ranges of Waziristan and also in the upper Kurram Valley.

Extra-limitally it occurs in Afghanistan in the higher mountain ranges of north, central and eastern regions, e.g. Shibar Pass, Kabul and Herat (Niethammer, 1965 and Hassinger, 1968). It has been collected in most of the mountainous regions of Iran including the Elburz and Sande-sar (Lay, 1967) and it also occurs in the southern region of Trans-Caspia in Russia (Flint et al., 1965).

The Collared Pika can occasionally be a serious economic pest in Pakistan despite the fact that it occurs mostly in mountainous regions beyond cultivation. It can do damage

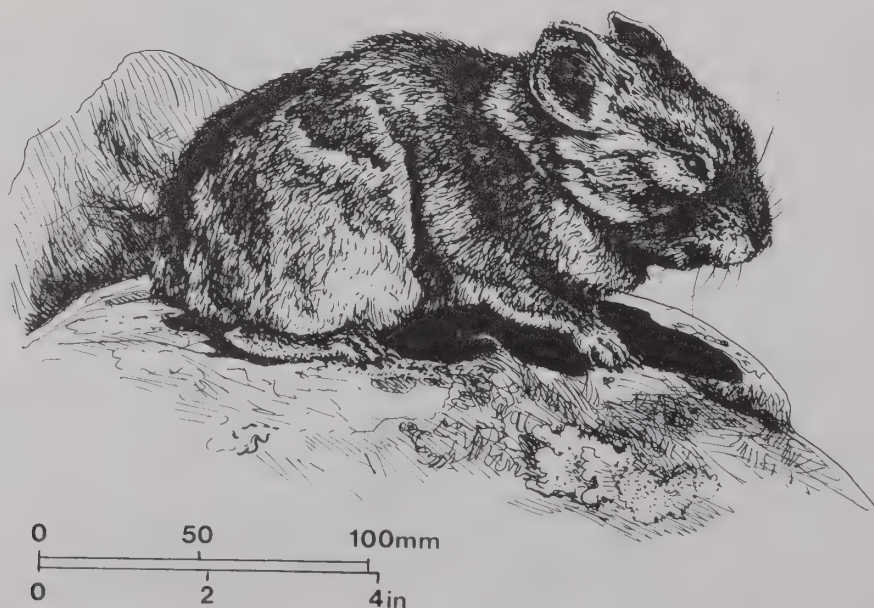


Illustration 63 *Ochotona rufescens*: Afghan Pika or Collared Pika. (Based on live captive adult male specimen collected early May in Ziarat, Baluchistan.)

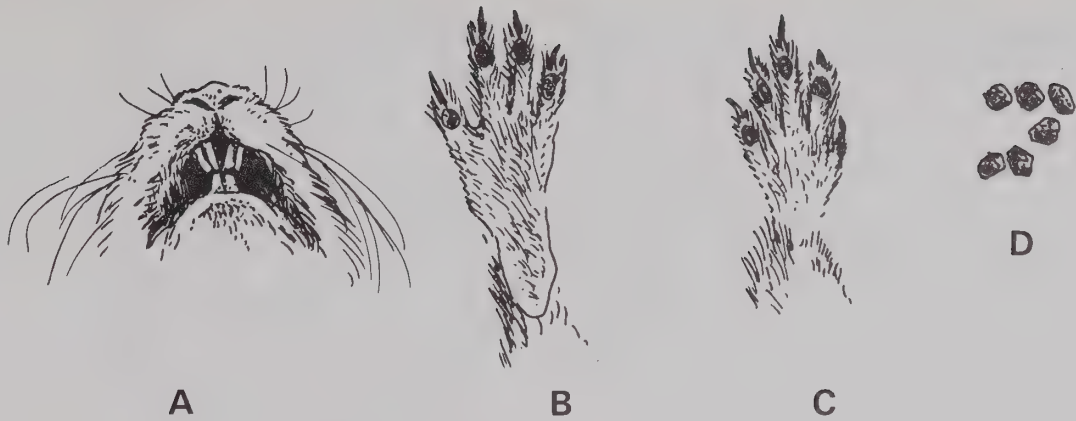


Fig. 58 Showing features of Pikas.  
A. Muzzle of *Ochotona rufescens* showing deep longitudinal grooves on surface of upper incisors.  
B. Sole of left hind foot of *Ochotona rufescens*.  
C. Same, right fore-foot.  
D. Appearance of faecal pellets approximately actual size.

in March to young growing wheat which it crops to drag down into its burrow food stores, and also in winter by gnawing the bark off the boles of apple trees.

**Biology:** Pikas are gregarious, occupying burrows in loose colonies. They are diurnal, and despite the high elevation and severe winters typical of their habitat, do not hibernate. When a number of captive Collared Pikas were kept together, they seemed to prefer to shelter in physical contact with each other and did not show any intraspecific aggression. It is not known whether they share the same burrow system in the

wild. It is probable that in the winter months and the non-breeding season several individuals do share the same nest chamber. Collared Pikas will excavate their own burrows, often under juniper tree roots or in earthen embankments but the majority of burrows take advantage of natural cavities between rocks and stones and they particularly frequent dry stone walls surrounding small patches of cultivation in the remoter upland valleys. When excavated in soil the burrows of this species are quite shallow and seldom exceed 610mm (2ft) in length. It seems probable that they inhabit much deeper burrows when they can take advantage of natural tunnels under rock screes.

In the southern parts of Baluchistan and during the summer months, Pikas confine most of their activity to the early morning and evening. They may be active throughout the day when it is cloudy. In winter they are fond of sunning themselves on some exposed rock and may remain thus in the middle of the day. Pikas are herbivorous and appear to feed on a very wide variety of plants including the lower accessible leaves of various shrubs as well as forbes and grasses and young wheat. The Collared Pika like other members of the genus has the most interesting habit of biting off green vegetation and carrying it to an underground store. In Baluchistan they appear to be particularly industrious during March and April when new vegetative growth is at its height. Sometimes fresh cut green material is left at the mouth of the burrow so that it can dry out but quite often it is immediately dragged into the underground burrow. The mountain regions frequented by this species in Baluchistan are characterized by a specially low humidity and such underground stores of fodder probably dry out fairly quickly. This storing activity appears to be less apparent during the months of June and July but is again in evidence in the early autumn. These fodder stores provide essential supplementary food during the winter months. In winter time Pikas feed extensively on the bank of various shrubs and, where available, deciduous fruit trees.

All the Pikas have a number of vocalizations including a high pitched penetrating whistle. The Collared Pika however has a comparatively weak voice. It emits a rather quavering whistle which can only be heard at close range. It is not known whether this whistle is a warning signal to other mem-



Distribution Map 78 : Royle's or Indian Pika.  
Afghan or Collared Pika.



bers of the colony. Pikas can signify danger by drumming rapidly on the ground with their hind feet, a habit shared with other diurnal gregarious rodents, e.g. *Meriones burrianae* and *Marmota caudata*.

Pikas are remarkably agile considering their short legs, and can leap over large rocks with great rapidity. The Collared Pika has been observed leaping onto a rock ledge over a distance of 610mm (2ft) (Ognev, 1940). They exhibit a mixture of extreme curiosity and shyness particularly in regions where they are not much disturbed or persecuted. They will often climb onto a prominent rock in order to observe a human intruder more closely. If one makes a sudden movement they disappear almost more rapidly than the human eye can perceive only to reappear a few moments later on some more distant vantage point. By sinking slowly out of sight behind some large boulder I have had *O. roylei* run almost up to my face to investigate.

Observations on Collared Pikas show that they also practice coprophagy (Walker et al., 1964) and eat their night-time faeces like the *Leporidae*. Their day-time faeces are greenish-brown in colour and 3–4mm ( $\frac{1}{8}$ – $\frac{5}{32}$  in.) in diameter and quite round in shape in contrast to the elliptical faeces of *Meriones persicus* with which it often shares adjacent burrows (see Fig. 58). Pikas have a habit of depositing their faeces in one particular place just in front of their burrows so that large accumulations often occur, thus betraying their presence. Captive Pikas when fed on fresh green food produced copious urine in sharp contrast to several rodent species from the same region. In the wild state most Collared Pikas inhabit regions where there is no available free water for drinking and they must obtain all their requirements from green vegetation, and through carbo-hydrate metabolism.

Collared Pikas from Baluchistan were successfully bred at Quetta in captivity by J. A. W. Anderson though it is presumed that most of the litters were produced from wild caught females already pregnant. In 1968 he obtained eight litters between mid March and the end of April. The largest comprised nine young, two were of seven, three of five and the smallest litter, four young. Six would appear therefore to be a fairly normal litter size. The young are born naked and blind and helpless and normally the mother makes an underground nest of soft vegetable material in the burrow in which she produces her litter. According to studies of North American pika species the gestation period is about 30 days and females generally come into oestrus immediately after giving birth to young (Walker et al., 1964). It is probable therefore that most females in Baluchistan produce two litters a year, the second one being born in late June or July. In other Asiatic species of Pika the young open their eyes at about seven days of age (Ognev, 1940). It is not known at what age they are fully weaned but this appears to be between two and three weeks of age (Walker, et al., op. cit.). In Baluchistan, Pikas have many natural enemies and are undoubtedly one of the principal prey species for the Stone Marten (*Martes foina*) as well as the Booted Eagle (*Hieraaëtus pennatus*). Though the Pika is very agile, the Booted Eagle is a swift and dexterous hunter capable of plunging between trees and making lightning attacks and it preys very successfully on Pikas in Baluchistan. The much rarer Golden Eagle (*Aquila chrysaëtos*) as well as Pallas's Cat (*Felis manul*) prey on this species also. Captive specimens from around Ziarat were found to have a number of fleas (unidentified) in their body fur. According to various authorities they are commonly infected with internal parasites, including nematodes, tapeworms and round worms (Walker, op. cit., and Ognev, op. cit.). It is thought that they live to about three years in the

wild though there is no record of captive specimens having survived more than 12 months. (Crandall, 1964).

Pikas give evidence of being delicate and are unable to withstand high temperatures or rough handling. Newly-captured animals often die of shock or heart failure even though they suffer no physical injuries if they are handled too much. On two separate occasions captive pikas of this species when being transported from Baluchistan down to Sind died within half an hour of being exposed to higher temperatures and possibly increased atmospheric pressure down on the plains. A temperature of about 35°C (95°F) at Sibi proved lethal in one instance. The Collared Pika can often be trapped in the same habitat as *Meriones persicus* and *Calomyscus bailwardi* in Baluchistan.

## OCHOTONA ROYLEI

*Ochotona roylei* Ogilby, 1839; Royle's Pika or Indian Pika.

**Description:** This Pika is closely similar in appearance to *O. rufescens* except for having a slightly darker, more reddish-brown pelage. If a very large series of specimens are compared, Royle's Pika will be found to average slightly larger in size and it definitely has larger ears but there is much overlapping in size. As in the Collared Pika the fur is very soft and silky and there is a dark bluish-grey underfur. The circular ears are well covered with short hairs on both anterior and posterior surface and in typical Pakistan specimens measured 25mm (see account of *Ochotona macrotis* below, p. 217). The body hairs are tipped dark reddish-brown to cinnamon and there is no sign of any paler collar of hairs at the base of the neck characteristic of *O. rufescens*. In adult specimens the lower flanks have an admixture of dark grey-brown hairs with the top of the head and neck more rufescent. The body measurements of 20 specimens from Hazara District and Swat Kohistan were as follows: head and body length averaging 191mm (range 170–225mm). Hind foot averaging 34mm (range 30–36mm) and the ear averaging 25.3mm (range 20–29mm). There is no tail. The entire sole of both fore and hind feet are covered with hair in the winter moult but in summer the plantar pads are exposed.

**Distribution and Status:** Royle's Pika is characteristically associated with broken slopes or talus in the Himalayan ranges (see Map 78). These mountain screes may or may not have forest cover but the Pika seems to be quite local in occurrence being entirely absent from some apparently suitable regions. It is generally associated with deodar (*Cedrus deodara*) or spruce (*Picea morinda*) forest if these trees grow amongst tumbled rock falls. They occur as low as 2400m (7900ft) in Hazara District up to 3600m (12,000ft) in Gilgit, and probably much higher in Baltistan (See *O. macrotis* below). They have not been found anywhere within the zone of Himalayan moist temperate forest even where broken rocky slopes occur.

They occur on both sides of the Kunhar River in Hazara District, and no doubt extend throughout the Indus Kohistan as they have been trapped in Swat Kohistan. They have been collected in the Bogamarg Valley, north west of Manshera and also above Sharan. Its distribution in Chitral and Gilgit has not been worked out but it has been collected near Phandar, to the west of Gupis and no doubt extends through to the southern mountain regions of Chitral. It has not been recorded in Afghanistan but this species extends eastwards

across the inner Himalayan ranges as far as Nepal (Prater, 1965). If it can be considered conspecific with *O. Macrotis* it also occurs in Tibet and in Russia in the extreme south east of Tadzhikistan (Bobrinskii et al., 1965) (see the following account of *O. macrotis*).

Royle's Pika does not frequent mountain areas where much cultivation is possible and they cannot be considered of any economic importance as they feed on a wide variety of herbs and grasses.

**Biology:** The habits of this Pika are essentially the same as the Collared Pika though very little has been recorded from actual field observations of this species.

They are loosely colonial, diurnal in activity, timid yet strangely confiding and tame. They appear to make use of a variety of green food and have been seen feeding on many different plant species including thistles and astragalus species in Gilgit, as well as the lower leaves of honeysuckle bushes (*Lonicera* spp.) in the Kaghan Valley. They do not hibernate in winter and also have the habit of cutting stores of plant food which are piled beneath rocks until they are dried out and then carried into their underground burrows. Royle's Pika has to contend with heavier snowfall in winter as compared with the Collared Pika in most of the regions which it inhabits. It is believed that they make tunnels beneath the snow to reach their various food stores in winter. Their burrows are often difficult to detect because they make more use of natural rock cavities and live more exclusively in regions of rock talus as compared to *O. rufescens*. In winter and early spring they will gnaw the bark off low bushes and twigs when green food is scantily available.

The breeding of Royle's Pikas seems to extend from the late spring until the late summer. Though there are no actual records of date of birth or litter sizes, juveniles partly grown have been trapped in mid July as well as at the end of September. The mid July specimens were about two-thirds of adult size and could be presumed to have been born in May. The September specimen was smaller and might have been born in August. It seems likely that females are capable of producing two litters in a year as is the case with most other Pikas.

Royle's Pika has a thin piping whistle which is a louder call-note than the Collared Pika. I have observed that when giving this call the Pika jerks its whole body upwards.

Probable predators, in the area frequented by the Pika, are the Stone Marten (*Martes foina*), the Stoat (*Mustela erminea*) and in its more northerly habitat the Altai Weasel (*Mustela altaica*). Since they do not hibernate in winter they are certainly a vital food source to smaller carnivores capable of entering underground rock crevices.

Very often the Migratory Hamster (*Cricetulus migratorius*)

and the High Mountain Vole (*Alticola roylei*) can be trapped in the same region as this Pika.

## OCHOTONA MACROTIS

*Ochotona macrotis* Günther, 1875; Large-eared Pika.

### Taxonomy

M. S. Siddiqi lists this species in his checklist of Pakistan Mammals (1961 and 1970) and it is also recorded in Ellerman and Morrison-Scott's checklist as occurring in Pakistan (1951).

This Pika was first described from a specimen collected in the border regions between Chinese Turkestan and the Karakorum Range in Pakistan (Günther, 1875). It has also been recorded in Ladakh and in south east Tadzhikistan in Asiatic Russia. It is exactly similar in appearance and size to *O. roylei* except for its ear averaging slightly bigger. Ellerman and Morrison-Scott (1951) in their key separate it from *O. roylei* on the basis of the ear measuring 27mm ( $1\frac{1}{16}$  in.) or more in length, but a number of specimens of *O. roylei* from Hazara District and Gilgit have been collected by myself and the University of Maryland Expedition with ear measurements of 27mm ( $1\frac{1}{16}$  in.) up to 29mm ( $1\frac{1}{8}$  in.). The Gilgit specimens show a tendency to a larger average ear size. The latest view of Russian authorities is that *O. macrotis* is only separable as a subspecies of *O. roylei* and that the two are conspecific (I. I. Sokolov and I. M. Gromov, Zoological Institute of Leningrad, in lit., 1971).

Hardly any *Ochotona* specimens have been collected from the northern parts of Gilgit and Baltistan, so that it is not possible to determine whether the range of these two species actually overlaps or whether they can be considered allopatric. The Russian viewpoint seems logical until further contrary evidence is forthcoming.

In Baltistan Pikas occur in rocky scree and talus slopes generally at higher elevations. These are treeless regions though Dwarf Juniper (*Juniperus polycarpus*) sometimes grows on such slopes.

S. I. Ognev records *O. macrotis* as cutting and drying *Astragalus frigidus* for its winter food-store (Ognev, 1940). In Ladakh and Baltistan this Pika is believed to be the principal food species of Pallas's Cat (*Felis manul*).

Within Pakistan territory the only definite records for *O. macrotis* are around Skardu but it must occur northwards throughout the Karakorums in view of its original discovery on the southern border of Chinese Turkestan. *O. roylei* subspecies *macrotis* occurs in the USSR throughout the Alma-Ata Desert, the vicinities of Karakul, Przewalski, Konylu River, Kirghizia, on the Kargalii Pass as well as around Rang-Kul Lake and Janimass (I. Sokolov, in lit., 1971).



## 12 RODENTIA

This order comprises the gnawing mammals and is worldwide in distribution. Adaptive radiation is conspicuous in this group of mammals. Fossorial, aquatic, volant, arboreal and cursorial forms are represented. Diet is equally variable. Rodents exhibit the following general characters: (1) one upper and one lower pair of continuously growing chisel-like incisors or gnawing teeth; (2) the presence of a distinct diastema due to the absence of canines and a reduction in the number of pre-molars; (3) cheek teeth with large grinding surfaces composed primarily of cement and dentine, patterned with loops or folds of enamel; (4) unguitrigrade, five fingered and three to five toed, plantigrade or semi-plantigrade; and (5) *Os penis* or *os clitoris* usually present.

Rodents are well represented in Pakistan; representatives of the three major sub-orders are present though the Myomorph species are the most abundant. Many rodent species are of economic and public health importance. Plant food-stuffs and habitations are frequently shared with man. The beneficial aspects of rodents in Pakistan have not been thoroughly investigated although in some parts of the world such species as Beaver, Muskrat, Chinchilla and Nutria are of commercial importance in the use of hides.

### FAMILY SCIURIDAE — SQUIRRELS, CHIPMUNKS, etc.

There are above 50 genera in this family which inhabit all parts of the world except Madagascar and Australia. In the *Sciuridae* the attachment of the masseter muscle extends up ahead of the zygomatic arch and forms a groove in the upper jaw-bone. The family, besides including the arboreal squirrels and flying squirrels, embraces Marmots, Susliks and Ground Hogs. The molars or grinding teeth are always rooted and tend to be slightly cuspid (i.e. have points or ridges at their outer corners). It is difficult to generalize about such a large family but many of the *Sciuridae* are comparatively large rodents with bushy tails. Most of the holarctic species undergo winter hibernation and many of them are diurnal in feeding activity.

#### Key to the Family SCIURIDAE

Dental formula: incisors 1/1; canines 0/0; pre-molars 2 or 1/1; molars 3/3.

Tail covered with long hairs throughout its length and bushy in appearance.

Cheek teeth unspecialized, rooted and tubercular. Five hind toes. Fibula not fused with tibia. Externally modified for terrestrial or arboreal life.

#### Genus PETAURISTA Link, 1795

The genus *Petaurista* comprises the Giant Flying Squirrels of which five species occur in the tropical and subtropical zones of South East Asia, extending northwards to Korea and Japan and eastward to Borneo. The Giant Flying Squirrels like all the flying squirrels have developed a broad parachute-like

flap of skin which extends on either side of the body between the limbs and which enables them to glide through the air for considerable distances. They can be distinguished from the Small Flying Squirrels of the Genus *Hylopetes* by the presence of an additional flap of skin extending from the heel of the hind-leg to the base of the tail (see Fig. 61).

#### Key to the Genus PETAURISTA

Head and body length over 300mm. Adapted to gliding with elastic membrane attached to flanks and from heel to base of tail. Upper incisors reddish. Molars tend to be flat crowned and less cuspidate than in other squirrels (see Fig. 59).

#### Key to the Pakistan Species of PETAURISTA

Dorsal pelage rich chestnut brown. Tail black tipped and hind foot with completely naked sole.

... *Petaurista petaurista*

#### PETAURISTA PETAURISTA

*Petaurista petaurista* Pallas, 1766; Giant Red Flying Squirrel or Indian Giant Flying Squirrel (see Illustration 64).

Subspecies *P. petaurista albiventer* Gray, 1834.

**Description:** This is a polymorphic species with considerable variation in pelage colouring, but only one subspecies *P. petaurista albiventer* occurs in Pakistan. It is a large handsome squirrel with the hair on the upper part of the body long, thick and silky and coloured a dark mahogany-red. In the dorsal region there is a scattering of creamy-white guard hairs. The long tail generally averages slightly more than the head and body length. It is not so thickly bushy as compared with the diurnal squirrels nor is it so conspicuously flattened dorso-ventrally as in the Genus *Hylopetes*. The tip of the tail is black, the rest of it being the same colour as the dorsal body fur. When at rest the tail is carried curved over the back with the extreme distal portion curled back upon itself or often curled round the hind part of the neck. The head is rounded with a blunt muzzle, the lower jaw being typical of a rodent and considerably shorter than the upper. The area around the nose is only sparsely haired and pinkish in colour. The rest of the face is reddish-chestnut with a ring of black hairs circling the eye and the upper part of the tip of the muzzle. The eyes are large and dark brown. The ears are well covered with hairs on both surfaces, lack any apical tufts and do not project above the top of the head. The incisors are covered with orange-red enamel. The belly fur tends to be rather coarse and sparse even in specimens secured at high elevations. It is pinkish-orange colour, aptly described as salmon-buff. Females have six mammae. The male has testes situated externally in a scrotal sack which may measure up to 20mm ( $\frac{13}{16}$  in.) in length in the breeding season.

Both fore and hind feet are clothed with short black hairs on their dorsal surface and there are five toes on the hind and four toes on the fore-feet with the first digit or pollex being vestigial. All digits bear very sharp recurved claws. The

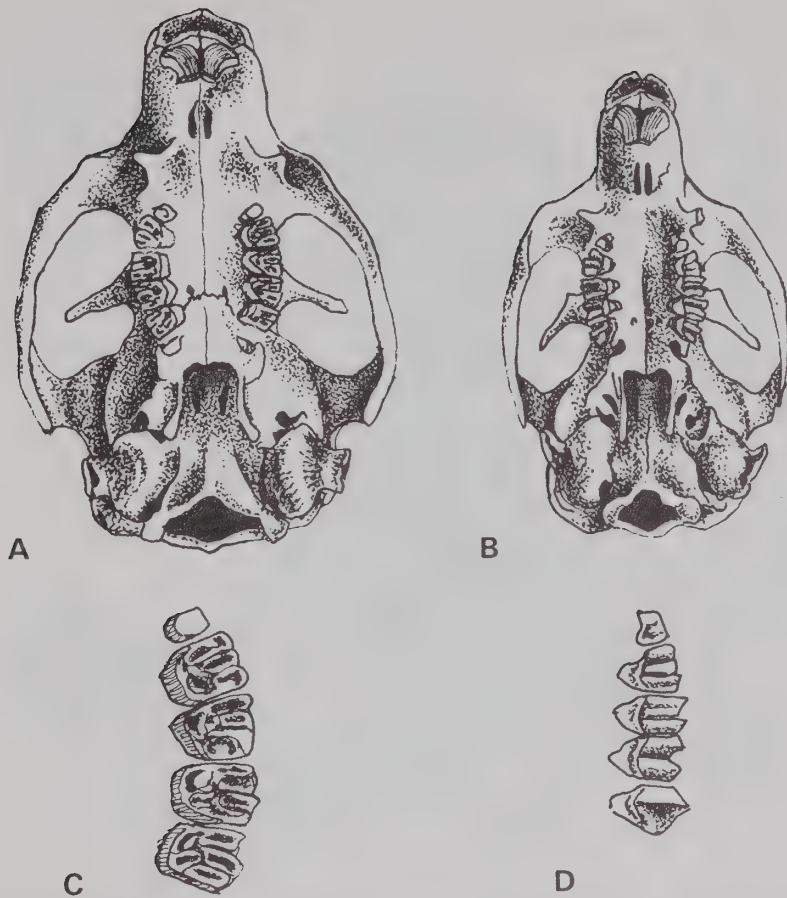


Fig. 59 Showing difference between skulls of *Petaurista* and *Hylopetes* genera of Flying Squirrels.  
A. Ventral view *Petaurista petaurista*.  
B. Ventral view *Hylopetes fimbriatus*.

C. Detail of left side maxillary tooth row of *Petaurista petaurista*.  
D. Detail of left side maxillary tooth row of *Hylopetes fimbriatus*.  
Note grinding surface of teeth more cuspid.

hind feet have naked black soles extending from the heel (see Fig. 60). The flap of skin which acts as a parachute in gliding, stretches from the wrist to the metacarpal joint of the hind leg. It is extremely elastic and does not appear particularly conspicuous when the animal is at rest or moving about in the branches of a tree. On the outer edge of the fore-legs just behind the wrist there is a cartilaginous spur which can be erected at will (see Fig. 60). This spur is about 70mm in length in adult specimens, and serves to stretch the parachute flaps when the animal is in flight. There is no intervening tissue, except small blood vessels, between the gliding membrane which consists simply of a double fold of hair covered skin.

Dimensions of 10 specimens from the Murree Hills and Hazara District are as follows: head and body length averaging 398mm (range 326–490mm). The tail length averaging 422mm (range 380–445mm). The ear length averaging 47mm (range 45–50mm) and the hind foot averaging 76mm (range 65–82mm). Females average slightly smaller than males. The largest male weighed 1.704kg (3¾lb) and the smallest female 1.137kg (2½lb).

**Distribution and Status:** Being arboreal, this flying squirrel is confined to forest areas and in Pakistan occurs mainly in Himalayan moist temperate forest. It has extended its range in the west into Deodar forest, and appears to des-



*Petaurista petaurista* Known distribution  
Probable range

Distribution Map 79 Giant Red Flying Squirrel.



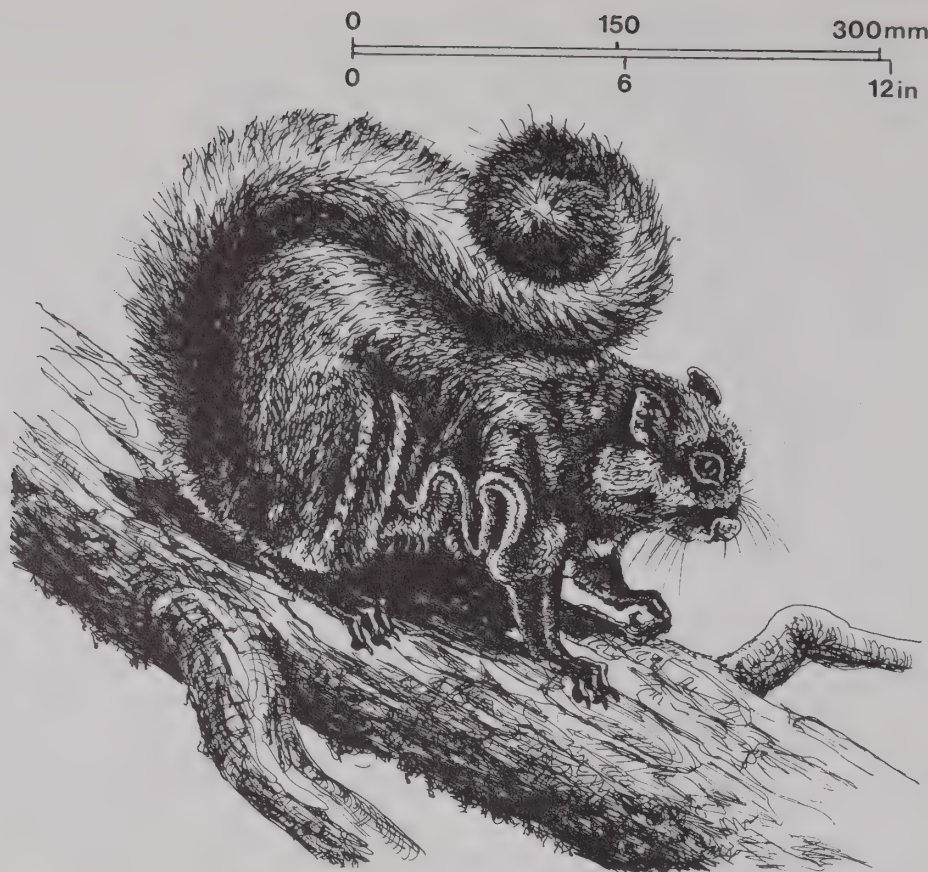


Illustration 64 *Petaurista petaurista*: Giant Red Flying Squirrel. (Based on live captive specimen, sub-adult male in late August from Dunga Gali, Murree Hills.)

cent to the tropical pine zone in winter but generally speaking it is not so adaptable ecologically as *Hylopetes* and has not extended its range into the northern regions where Himalayan dry coniferous forest predominates.

The area of suitable forest where this squirrel can be found is comparatively limited in Pakistan. *Petaurista* occurs in the Murree Hills, the Neelum Valley of Azad Kashmir and the southern part of Kaghan Valley from about 1350m (4500ft) elevation to the upper limit of the tree line. It occurs in the eastern part of Swat where it is considered to be uncommon according to local hunters. Captain Fulton recorded it as being common in the Deodar forests of lower Chitral (Fulton, 1903). It must occur in parts of Dir though there appear to be no definite records. It occurs in the Siran Nullah west of the Kaghan Valley. In all these regions it is sympatric with the Small Kashmir Flying Squirrel and it appears to be more plentiful than the latter species, only in moister forest regions.

In the Kaghan Valley there is an interesting melanistic population. The University of Maryland expedition collected three specimens in 1964 and 1965. Z. B. Mirza collected a specimen near Shoghran in 1965 and the author obtained a skin from Naran in 1966. These specimens are completely black dorsally and ventrally with typically long silky fur. Another pure black specimen from Dunga Gali in the Murree Hills was reliably reported killed by a local hunter in 1973. Normally coloured red specimens occur in the same area, though the black form is well known to local hunters. F. Finn mentions a melanoid variety of this species collected from

Kashmir, now lodged in the Leyden Museum in Germany (Finn, 1929). Extra-limitally the Giant Red Flying Squirrel extends across the Himalayan chain through India, Nepal, Assam, northern Burma, Malaysia and Indo-China. J. Niethammer obtained the first record of this squirrel in Afghanistan where it was found in Deodar forest in Nuristan (Niethammer, 1967). It has also been subsequently collected in Pakthia near Safed Koh in Afghanistan (Niethammer, in lit.). This represents the extreme western limit of its range. It occurs nowhere in Russian territory (Sokolov, in lit.).

It is not a particularly shy species when encountered at night, but it shuns human habitations in contrast to the Small Kashmir Flying Squirrel. Its pelt occasionally appears in the fur shops of Murree and Rawalpindi but it is of little economic importance as the skin is so thin and tears easily. It is not a serious factor in preventing natural forest regeneration, despite the fact that it feeds on young fir cones and other tree seeds, since all the areas in Pakistan where it occurs have a relatively high human population with grazing domestic stock as well as grass cutting and burning. In such forest areas human and domestic animal disturbance largely inhibits such regeneration and far outweighs the depredations of the combined wild rodent population.

**Biology:** Because it is strictly nocturnal, this large squirrel is seldom seen and not much has been recorded about its life habits though it is by no means rare even in well populated regions such as the Murree Hills.

They spend the day lying curled up asleep in a tree hollow

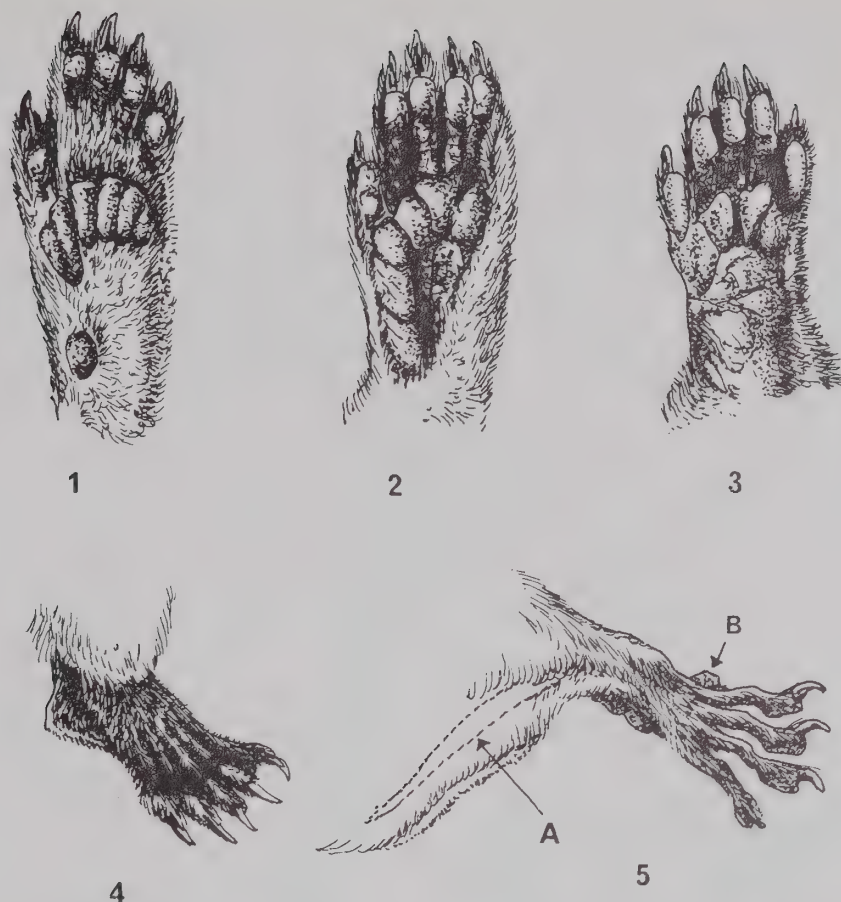


Fig. 60 Showing distinction between hind foot of Flying Squirrel species in Pakistan, and other features.

1. *Eupetaurus cinereus*.
2. *Petaurista petaurista*.
3. *Hylopetes fimbriatus*.

Note restricted naked plantar pad of *Eupetaurus*

with sole of hind foot of *Hylopetes* comparatively naked and *Petaurista* intermediate.

4. Dorsal view right hind foot of *Hylopetes fimbriatus*.
5. Dorsal view right fore-foot of *Hylopetes fimbriatus*.  
A. Showing approximate position of cartilaginous wrist spur when extended.  
B. Vestigial thumb.

usually at a considerable distance from the ground and do not emerge to start feeding until well after darkness. I was able to keep a captive specimen for just under six months. Throughout the day it slept curled in a tight circle with its tail wrapped over its body and head. It slept either on its side or ventrally. After dark it became naturally active and spent a considerable amount of time licking its fore-paws and grooming its fur. When moving on the ground it appeared comparatively clumsy as compared with diurnal squirrels. It kept its fore-feet with the digits curled in a semi-closed position and the claws clear of the ground putting its weight on the carpal joints only. It was however capable of rapid movement when frightened. When approached by a strange person it emitted a low growl and made lightning swipes with its fore-paws. Since these are armed with very sharp claws, this squirrel could be quite a formidable adversary to an attacking marten (*Martes* spp.) in the confined space of a tree cavity.

This squirrel appears to subsist largely on young green fir and pine cones and to a lesser extent on leaves and young twigs and tree buds. When available in season they also eat various fruits and nuts, particularly the acorn of the hill oak (*Quercus dilatata*) in October, and walnuts (*Juglans regia*) in September. These trees are characteristic of the Himalayan moist temperate forest. No doubt when opportunity avails

they supplement their diet with insects and eggs of wild birds as do other squirrel species. Related *Petaurista* species from Taiwan have been recorded as eating birds' eggs. Examination of stomach contents of specimens killed in the Murree Hills in June, July and August revealed only an unidentifiable paste of leaf tissue. My captive specimen relished dried raisins and any nuts but refused most kinds of green leaves from species of trees and shrubs grown in the plains. In winter-time they probably feed principally upon the buds of pine trees as well as green immature pine cones (see Fig. 61).

Despite the cold northerly latitudes occupied by this tropical oriental species in Pakistan, they do not hibernate in winter. It probably undergoes altitudinal migration where suitable forest is available. In the first week of January a specimen was disturbed in the middle of the day from its shelter in the hole of a tree at about 760m (2500ft) elevation, in tropical dry pine forest in the Lehrar Valley. Disturbed by a village boy beating on the trunk with a stick, the animal made a very rapid escape jumping from tree to tree (Mrs. S. C. Edwards, pers. comm. 1971). Their continued activity throughout the winter months even in conditions of deep snowfall is also corroborated by local villagers in the Murree Hills.

The most intriguing aspect of this squirrel's behaviour is its gliding ability. They run up to one of the topmost branches



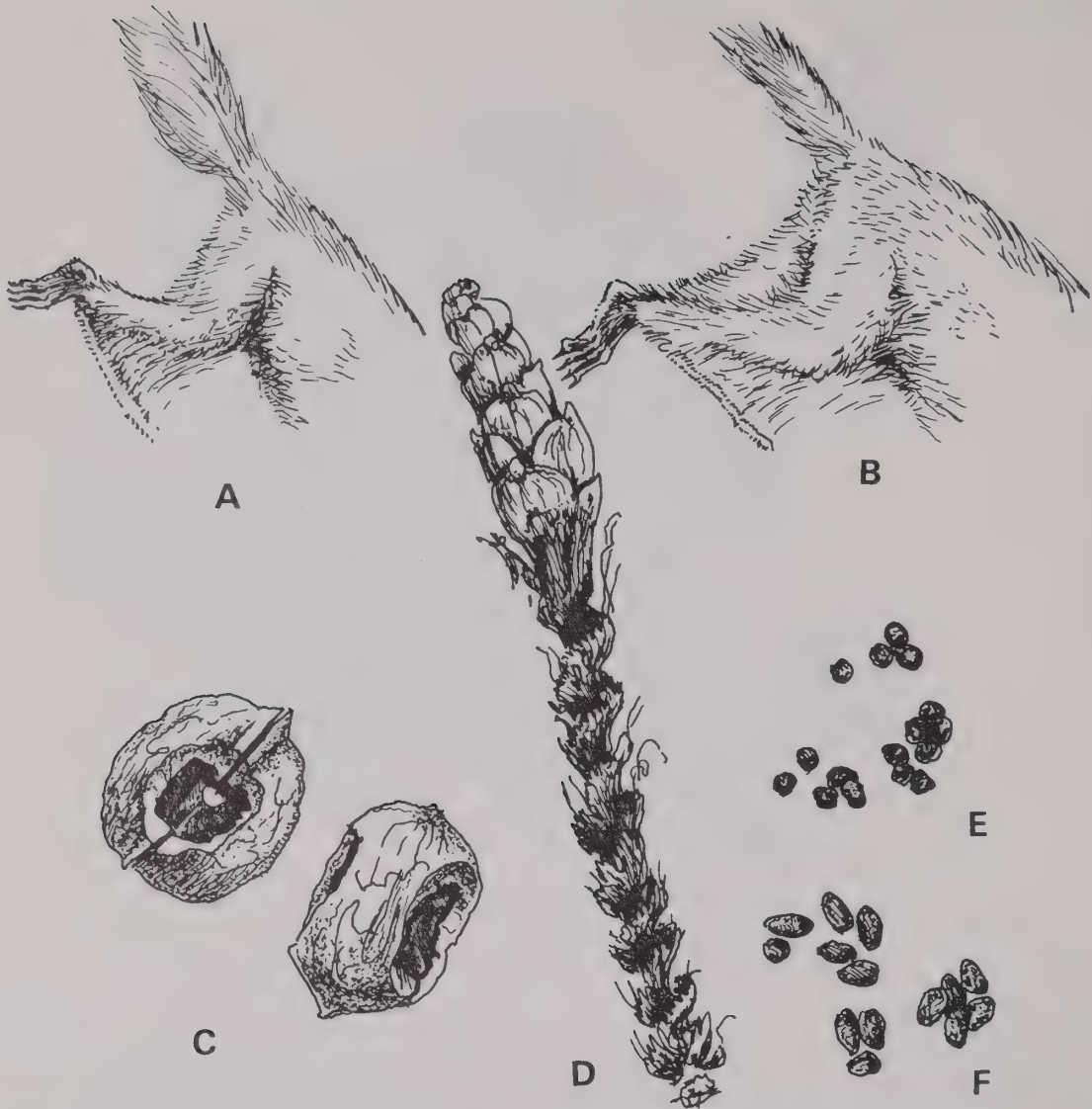


Fig. 61 Showing distinction between *Petaurista* and *Hylopetes* genera and field signs of Flying Squirrel feeding activity.

- A. Right hind leg of *Hylopetes fimbriatus* without skin flap between base of tail and heel.
- B. Same view *Petaurista petaurista* showing flying membrane extending to posterior part of hind-leg.
- C. Walnuts (*Juglans regia*) showing quadrilateral

holes gnawed in each segment with kernel neatly extracted (*Hylopetes fimbriatus*).

- D. Immature cone of Blue Pine (*Pinus wallichiana*) eaten by *Petaurista petaurista*.
- E. Characteristic appearance of faecal pellets of *Hylopetes fimbriatus*. Actual size.
- F. Characteristic appearance of faecal pellets of *Petaurista petaurista*, approximately actual size.

of a tree before commencing a glide and can cover very considerable distances when gliding down a steep mountain slope. There is a clearly audible rushing sound when this squirrel passes overhead and the noise of their impact on the tree on which they land after such a leap can be heard from a considerable distance. I measured one such leap on a very gentle slope covering 75m (240ft) between two trees. Just before the end of their glide they bank steeply and extend all four feet to lessen the shock of impact. They invariably land on a vertical tree trunk and it always seems amazing that they do not injure themselves when landing at such velocity, in the dark, on vertical surfaces which contain sharply projecting branches. Observations on a captive specimen showed that it could steer itself in mid flight when leaping across a room and avoided a hanging ceiling fan (Minnett, 1947). Observations on captive *Glaucomys* species indicate that they steer in flight

by raising or lowering one of their forearms (Walker et al., 1964).

Little is known about their breeding biology. Though the females have six mammae, litter sizes appear to be small according to limited available evidence. A nest containing two young was discovered by a local hill boy near Dunga Gali in late July. Prater states that two is the normal litter size (Prater, 1965). The female builds a rough nest of leaves and twigs in which the young are born. The nest may be partly concealed in the fork of a tree or may be entirely concealed in a tree cavity. F. W. Champion (1933) describes a nest of this species in Kumaon (India) situated at 9m (30ft) in the fork of a tree. The nest was domed like that of the Magpie (*Pica pica*) and lined with pine needles. The nest discovered at Dunga Gali, according to indirect reports, was in a tree-cavity. One of the two young taken died within a few hours

but the second showed no fear of humans when in the possession of a local villager. The young are believed to be comparatively slow growing and probably do not open their eyes until they are thirty days old and it is believed that they suckle for 2–2½ months. The young of a closely related species (*Petaurista philippensis*) when captured at three or four months of age still had a comparatively large head and also comparatively large feet whilst the parachute fold of skin was undeveloped and extended only up to the elbow of the fore-arms with no evidence of the wrist spur which is developed in adult specimens (Hutton, 1946). The nearly full grown young secured by me in the Murree Hills had apparently fallen out of its nest at the end of May. In Pakistan it appears that young may be born from early March up to July or early August.

Flying squirrels are quite vocal at night and individuals call in a monotonous repeated wail reminiscent of a child moaning. When heard at close range the call seems to be expiratory with an audible sound of the animal breathing outwards. The call may be repeated up to twenty times at one to two second intervals. It is unusual to hear it before about 9pm in the summer months but once I heard it at 4.30pm in a secluded ravine. Based upon recorded observations of various diurnal squirrels, it is probable that this was a mate attracting call. In Pakistan this squirrel probably produces two litters in a year varying from two to three young.

A captive specimen of the Giant Flying Squirrel lived for 11 years in the Calcutta Zoo (Minett, 1947), and another specimen lived 16 years in captivity (Dover, 1933). Besides being slow maturing they are apparently rather long-lived rodents. There are interesting observations on the behaviour of a captive specimen which survived for two years in a semi-free condition in Kumaon (Minett, op. cit.).

The Yellow Throated Marten (*Martes flavigula*) as well as the Leopard Cat (*Felis bengalensis*) are the main predators of this flying squirrel and since the former hunts partly by day and can probably surprise the squirrel during its sleep, it is likely to be a more serious predator.

### Genus HYLOPETES Thomas, 1908

There are six species in this genus found throughout south east Asia. They can be distinguished from the genus *Petaurista* by their smaller average size and relatively shorter tail which has the hairs spreading laterally in a feather shape. The tail therefore adds significantly to the parachute or gliding surface when the animal is leaping.

### Key to the Genus HYLOPETES

Head and body length generally under 300mm. Adapted to gliding, with elastic membrane attached to flanks but no membrane from heel to base of tail (see Fig. 61). Skull with tympanic bullae not specially flattened and with last pre-molar not smaller than first molar and cheek teeth cuspidate (see Fig. 59).

### Key to the Pakistan Species of HYLOPETES

Dorsal fur grizzled black and pinkish buff. Tail with extensive black tip and flattened ventro-dorsally with hairs radiating outward like a feather.

. . . *Hylopetes fimbriatus*

### HYLOPETES FIMBRIATUS

*Hylopetes fimbriatus* Gray, 1837 Small Kashmir Flying Squirrel (see Illustration 65).

**Description:** As its name implies it is a smaller squirrel than *Petaurista*, having a comparatively shorter tail, more up-standing prominent ears, and a relatively larger head. Being nocturnal they have the same very large eyes as *Petaurista* but the muzzle is more elongated. The ears are almost hairless with the outer margin sharply concave towards the tip, so that the pinna characteristically bends backwards. The body fur is shorter and less luxuriant than in *Petaurista*. The belly fur is creamy white in colour varying to dull greyish-buff. The dorsal fur is a dull pinkish-buff colour mixed with black hairs so that the general appearance is grizzled. As already indicated the tail is broad at its base with the hairs radiating outwards to form a flattened surface dorso-ventrally. It tapers to a point and has an extensive black tip being a sandy-red colour in its proximal region.

As in all the flying squirrels there is an extensive flap of elastic skin stretching from the wrist of the fore-limb to the hind feet. When leaping, this skin flap is also extended and tautened by a cartilaginous wrist-spur similar to that found in *Petaurista*. But the spur measures about 40 to 42mm. Female *Hylopetes* have six mammae.

The naked palms of fore and hind feet are pinkish-brown and all the digits are armed with very sharp claws (see Fig. 60). The upper surface of fore and hind feet is covered with dark brown hairs and like *Petaurista* there are five toes on the hind foot and four on the fore-foot together with a vestigial thumb. The incisor teeth are coated with a bright red enamel. The vibrissae are long, up to 83mm (3¼in.) and black in colour. Average dimensions of 11 specimens from Pakistan are as follows: head and body length 275mm (range 235–297mm), tail 295mm (range 252–330mm), with the hind foot 62mm (range 52–70mm) and the ear 44mm (range 37–48mm). An adult male from Nathia Gali weighed 510g.

**Distribution and Status:** The Small Kashmir Flying Squirrel is almost sympatric with the Giant Red Flying Squirrel, being mainly confined to Himalayan moist temperate forest which has a mixture of deciduous and coniferous tree species. However it is apparently more adaptable than the Giant Red Flying Squirrel to less mesic conditions and to living in more northern dryer regions where the forest is predominantly coniferous. In winter this species may descend into the tropical pine forest zone down to 900m (3000ft) elevation. It is also found in spruce forest (*Picea morinda*) in Gilgit and in Indus Kohistan regions where *Petaurista* apparently does not occur.

This is the commonest squirrel in the Himalayan forest and is also widespread in dryer forest zones characterized by deodar (*Cedrus deodara*) and holly oak (*Quercus ilex*) such as occur in southern Chitral, many parts of Dir and Swat Kohistan. Besides occurring throughout the Murree Hills, Hazara District and Azad Kashmir it also occurs in Gilgit in spruce forest (*Picea morinda*), as well as dry blue pine forest (*Pinus wallichiana*) on the slopes of Nanga Parbat, habitats which have not been invaded by the Giant Red Flying Squirrel. Since they are nocturnal, it is difficult to estimate their numerical abundance but from the evidence of partly eaten green pine cones and other signs on the forest floor it would appear that they are very plentiful in Swat Kohistan as well as the Murree Hills.



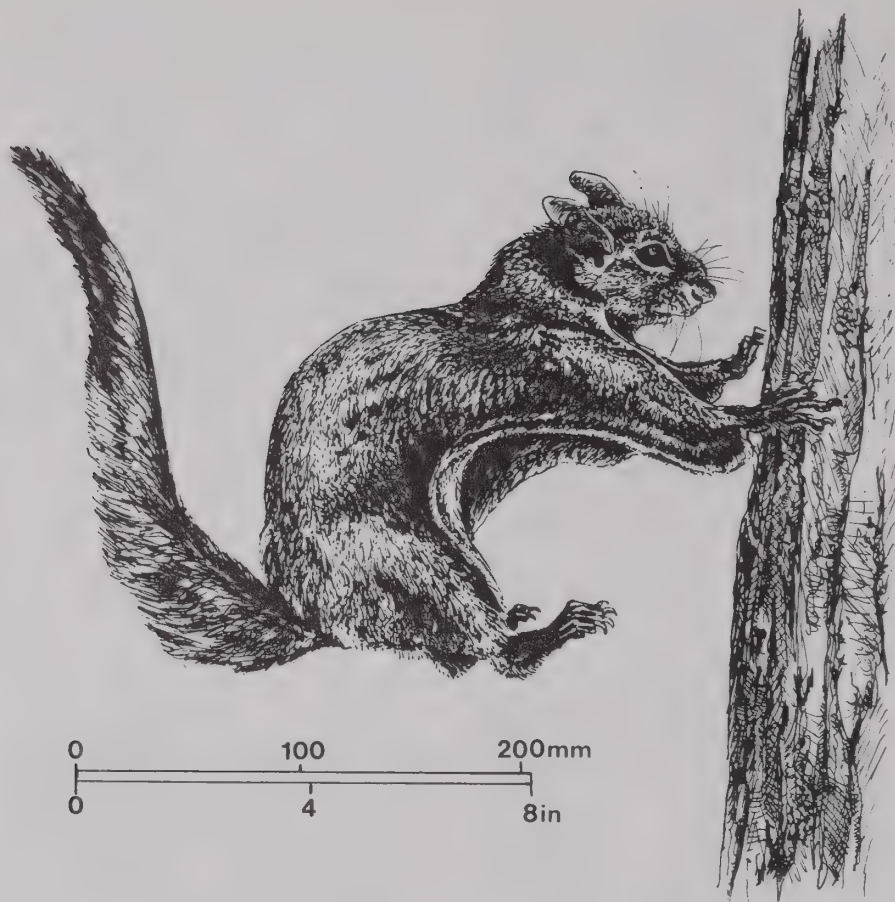
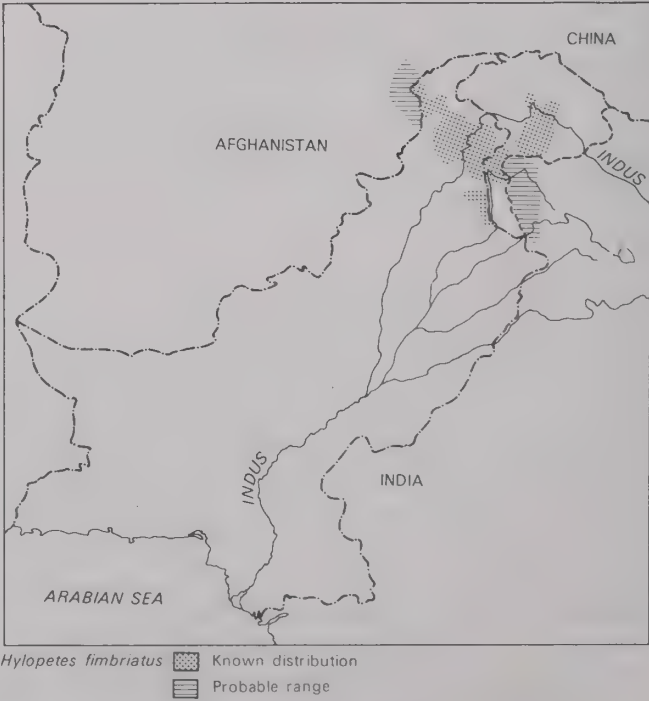


Illustration 65 *Hylopetes fimbriatus*: Small Kashmir Flying Squirrel. (Based on fresh killed adult female specimen from Dunga Gali, Murree Hills and captive specimens in possession of J. A. W. Anderson from Swat Kohistan.)

As in the case of the Giant Red Flying Squirrel it cannot be claimed that their tree-seed eating activities are of any economic importance since disturbance by domestic grazing flocks is generally the major factor inhibiting natural forest regeneration, and in more sheltered or remote forest regions it is possible to see signs of natural tree regeneration even in areas where *Hylopetes* is known to be common.

**Biology:** It is strictly nocturnal, like all the flying squirrels, spending the day curled up asleep in a sheltered hole, but it has more often come to the notice of visitors to Himalayan hill stations because it is not so shy of human habitations and very frequently chooses to shelter under the roofs of occupied houses. For example during recent repairs to the steeple of the little church in Nathia Gali a pair of Small Kashmir Flying Squirrels were found sleeping inside the belfry. In 1964 one or two Small Kashmir Flying Squirrels regularly spent the day sleeping under the eaves in the roof of an occupied house during the early part of the summer in Murree (Priddy, pers. comm., 1965). In the early part of the evening they could be heard making a considerable scratching noise in the roof and later during the course of the night landing on the galvanized iron sheets of the roof. Probably the majority of specimens, however, frequent natural tree hollows. They do not hibernate in the winter but descend down to the valley bottoms during the coldest months. In



Distribution Map 80 Small Kashmir Flying Squirrel.

Swat Kohistan I have observed that they are particularly fond of the acorns of the evergreen holly oak (*Quercus ilex*) as well as walnuts. They gnaw neat square holes on either side of the walnut from which they are able to extract the entire kernel, performing what would be a difficult feat for a human being, even armed with a suitable spiked tool, considering the small size of the hole (see Fig. 61). They also eat the seeds of young fir cones, especially those of the silver fir (*Abies pindrow*) in September and October, and they will eat immature cones of the blue pine (*Pinus wallichiana*) in a similar manner to *Petaurista*. In the Murree Hills and no doubt elsewhere they also eat young shoots and buds of the silver fir (*Abies pindrow*), as I have heard them actively feeding at night in such trees. Presumably they eat the leaves of other deciduous species also, though it is impossible to identify the species from an examination of stomach contents. A captive pair in the possession of J. W. Anderson relished ripe melons and also ate the seeds.

Practically nothing is known about their breeding habits, though the young appear to be born mainly in the summer months. A female which was still lactating was collected in Dir on 27 September but two sub-adult specimens shot in the Murree Hills on 18 and 19 September were three-quarters grown and obviously had been living an independent existence for some weeks. The squirrels obtained by J. W. Anderson consisted of a litter of two which were obtained in early August in Swat at which time they were fully weaned and may have been  $2\frac{1}{2}$  to 3 months old. By early November these two squirrels had reached full adult size. The Small Kashmir Flying Squirrel is probably more prolific than *Petaurista* since a female killed in Gilgit contained four fetuses (Ellerman, 1961). Also it appears to be more numerically abundant than *Petaurista* where the two species occur together. Litters of 3 to 4 may be not unusual and two litters a year can be produced by this species, the young not being independent until 2 to  $2\frac{1}{2}$  months of age. The female builds a special nest in the crotch of a tree or partly concealed in a hollow branch, in which the young are born. They are naked and helpless at birth and according to S. H. Prater (1965) probably do not open their eyes until they are almost three-quarters adult size.

Like its larger relative the Giant Red Flying Squirrel, *Hylopetes* is capable of prolonged glides. In Afghanistan Dr. Niethammer measured one such leap over 50m (160ft) distance (Niethammer, 1967). It is probably when gliding down a mountain slope that they can cover double this distance.

Nothing is known about the longevity of this species, and like all the flying squirrels they are very delicate animals, being notoriously difficult to keep in captivity. The principal predator of this squirrel is the Yellow Throated Marten (*Martes flavigula*). Scully's Wood Owl (*Strix aluco biddulphi*) which occurs in the same area is probably big enough to capture young and immature specimens. Since this squirrel practically never descends to the ground it escapes most other predators.

#### Genus EUPETAURUS Thomas, 1888

##### Key to the Pakistan Species of EUPETAURUS

Large size with unusually thick and long fur and elastic flying membrane attached to flanks. Tail unicoloured and grizzled blue-grey as also whole of upper part of body. Hind foot with sole hairy except for digital and front plantar pads (see Fig.

60). Teeth hypsodont with molars high crowned and having smooth flat grinding surfaces.

... *Eupetaurus cinereus*

#### EUPETAURUS CINEREUS

*Eupetaurus cinereus* Thomas, 1888; Woolly Flying Squirrel.

**Taxonomy:** This squirrel is of great zoological interest. Not only is it very rare and of restricted world distribution but it apparently shows quite unique ecological adaptations for surviving in regions which are inhospitable to any other flying squirrels.

J. Oldfield Thomas in describing the first specimen (1888) pointed out that its hypsodont molars contrasted with all other genera of flying squirrels which have comparatively low crowned and brachyodont molars and warranted placing it in a separate monotypic genus. Oldfield Thomas was able to examine three skins only. He noted that the claws seemed comparatively blunter than in the case of other flying squirrels and therefore hazarded the opinion that this squirrel was less adapted to a purely arboreal existence and probably lived largely on the ground in rocky terrain.

**Description:** Even without a detailed examination of the skull and teeth this flying squirrel is strikingly different from other species inhabiting Pakistan. It averages slightly larger in body size than the Giant Red Flying Squirrel but with a comparatively shorter tail. Since it has much longer and denser fur than *Petaurista*, specimens look considerably bulkier and bigger than the Giant Red Flying Squirrel. The tail is densely bushy and rounded, bearing hairs of 7.6cm (3in.) average length, so that it looks extremely thick and almost as broad as the body of the animal itself in sharp contrast to the long slender tail of *Petaurista*. The dorsal fur is grizzled brownish-grey having a scattering of pale buff-tipped hairs. From a distance the overall impression is quite blue-grey. The shorter belly fur is a paler grey. The tail lacks any terminal black tip. The muzzle is slightly longer than that of *Petaurista* species and Oldfield Thomas described it as being almost trumpet shaped. The throat often has creamy-white hairs and the ears are thickly fringed with pale buff hairs. The ear averages slightly smaller than a typical *Petaurista*. The strong-well-developed vibrissae are black. The feet are comparatively larger and longer than *Petaurista* with the soles more densely furred and showing a more restricted area of naked pads. The fur on the soles of the feet is blackish with the naked pads being pinkish brown and there are five strongly developed digits on the hind feet (see Fig. 60). The naked pads on the soles of the feet of *Petaurista* are black. It should also be noted that the pelage of this most handsome squirrel, is not woolly despite its common name and the hairs are quite straight and silky.

Two specimens measured 61cm (24in.) and 51.5cm (20 $\frac{1}{2}$ in.) from nose-tip to root of tail. The larger had a tail length of only 38cm (15in.) and the smaller one 48cm (18 $\frac{3}{4}$ in.) with the ear varying from 27–29mm (1 $\frac{1}{16}$ –1 $\frac{3}{16}$ in.) and the hind-foot measured 87mm (3 $\frac{7}{16}$ in.) in the larger specimen and 85mm (3 $\frac{3}{8}$ in.) in the smaller. This compares with 75mm (2 $\frac{1}{8}$ in.) length of the hind foot of a typical adult male specimen of *Petaurista*. A very large specimen in the collection of Bombay Natural History Society, from Chitral had the ear measuring 37mm (1 $\frac{1}{2}$ in.) and the tail only 370mm (14 $\frac{1}{2}$ in.).



**Distribution and Status:** This Flying Squirrel appears to be confined to remoter valleys in the extreme northern part of the Himalayas where the vegetation is adapted to steppic mountainous conditions. Forest is limited to isolated pockets in such regions and this consists largely of Blue Pine and spruce.

It has been collected in north east Chitral and in various parts of Gilgit including Astor, Hunza and Naltar. Z. B. Mirza recorded it as having been collected in the northern part of Hazara District and Chilas during the University of Maryland Expedition in 1965. This was, however, a case of mistaken identity (Mirza, 1970).

This flying squirrel is undoubtedly one of the rarer mammals in the world since the only known specimens at present besides the original type-specimen, consist of four skins in the British Museum collection and four skins in the collection of the Bombay Natural History Society. It is of special interest to Pakistan since its known world distribution

spring and that two litters in a year can be produced. At the elevation where this squirrel occurs new vegetative growth and particularly fresh buds on the conifers are only just starting to develop in April so that food supply is particularly poor earlier in the spring. The spruce tree (*Picea morinda*) produces new young fir cones at the end of the summer so that the seeds are shed in winter when the ground is carpeted with snow. Such spruce cones are an important food source for the Woolly Flying Squirrel, but until further evidence is available the breeding season must remain a matter of conjecture.

Despite the harshness of the winters in the region inhabited by this squirrel it does not hibernate, in common with the other Himalayan flying squirrels, and in fact there is one specimen in the collection of the British Museum which was shot on 22 January indicating that it must have been active and not hibernating on that date.

The development of its molars indicates that it lives on a highly fibrous vegetable diet as its teeth are adapted to a high rate of abrasion and wear on their grinding surface. In order to withstand the highly desiccating winds which are prevalent in the cold mountains where this squirrel exists, it is a fact that most plants have had to develop cell tissue with a high proportion of tough silicates and the molar development would seem ideal for coping with such plant tissue.

S. H. Prater (1965) repeats the opinion of W. Blanford who inferred that this animal probably lived mainly amongst rocks and was not a tree dweller. In actual fact this squirrel probably lives partly amongst tumbled rocks as well as migrating into forests when they offer a more abundant food supply. The specimen captured by Major Lorimer which provides the only known photographs of this animal, came from the Sai Nullah (valley) in Chilas District of Gilgit and there is pine forest in this valley (Lorimer, 1924). Similarly a specimen in the collection of the Bombay Natural History Society came from Naltar Valley in Gilgit which has extensive spruce forest. However specimens have also been collected in the northern part of Hunza, for example in the Shishpar Nullah and this region is devoid of any trees. So *Eupetaurus* can undoubtedly adapt itself to live in barren rocky areas and with its highly specialized grinding teeth it no doubt can supplement its diet during the winter months by eating the many varieties of lichens which cover the rocks.



Distribution Map 81 Woolly Flying Squirrel.

is practically confined within her borders. However there is one trade skin in the British Museum collection which was purchased in Gyantse Bazar, in Tibet. This indicates that its range probably extends northwards into Tibet.

It is also noteworthy that one of the specimens in the Bombay Natural History Society collection which came from Chitral shows partial melanism. Both dorsal and ventral fur is a dark maroon, almost chocolate colour, without the belly fur being lighter in shade. In all other respects this skin is a typical *Eupetaurus*, lacking the black tail tip, and also having very long thick hair, comparatively short tail and less extensive naked pads to the soles of the feet.

**Biology:** So little is known about this rare animal that one can only infer a little from the evidence of a few museum specimens.

There is one immature specimen in the collection of the British Museum which was secured on 17 April. This would seem to indicate that breeding can occur very early in the

### Genus FUNAMBULUS Lesson, 1835

This genus comprises a group of small diurnal arboreal squirrels which occur on the Indo-Pakistan subcontinent and Ceylon (Ellerman, 1961). All species of *Funambulus* bear conspicuous longitudinal stripes. One species inhabits Pakistan.

#### Key to the Genus FUNAMBULUS

Small size. Head and body length 120–170mm. Without any elastic membrane attached to flanks. With longitudinal pale stripes in dorsal area. Baculum without any accessory blades. Coronoid process of lower mandible low and reduced. Adapted for an arboreal existence with tail roughly equal to head and body length.

#### Key to the Pakistan Species of FUNAMBULUS

Dorsal fur greenish brown with five longitudinal creamy stripes.  
... *Funambulus pennanti*

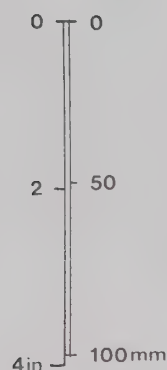


Illustration 66 *Funambulus pennanti*: Five Striped Palm Squirrel. (Based on fresh killed adult male specimen collected in February, Khanewal, Punjab.)

### FUNAMBULUS PENNANTI

*Funambulus pennanti* Wroughton, 1905; Northern Palm Squirrel or Five-striped Palm Squirrel (see Illustration 66).

**Description:** A small, but frequently seen, squirrel with rounded ears, dark bright eyes and a rather pointed muzzle. Fur of the head, neck, shoulders and outer limb surfaces is grizzled pale grey. The dorsal body area is an olive-grey-brown colour divided by three conspicuous longitudinal cream-coloured stripes, one mid dorsal and two lateral ones. The belly and lower flanks are creamy-grey and separated from the dark dorsal colour by indistinct creamy-buff longitudinal stripes. The long sparse hairs of the tail are creamy or white at tip and base with a black middle band. Variation in size appears related to habitat; specimens from more arid areas tend to be small. Examination of a series of more than 40 British Museum (Natural History) specimens revealed the following: head and body length 130–165mm ( $5\frac{1}{8}$ – $6\frac{1}{2}$  in.), tail length 120–160mm ( $4\frac{3}{4}$ – $6\frac{5}{16}$  in.), ear 16–18mm ( $\frac{5}{8}$  in.) and hind foot 35–42mm. Adults varied in weight from 100 to 155g. ( $3\frac{1}{2}$ – $5\frac{1}{2}$  oz). Five toes and four fingers with a vestigial thumb are present.

**Distribution and Status:** Common in large cities, villages and semi desert regions. Throughout the Indus plain it is associated with *Acacia arabica* and *Albizia lebbek*. These trees are commonly planted along roadsides and in villages and their seeds form an important part of the diet of *F. pennanti*. In the Mekran, Date palms are the dominant vegetation type occupied by these squirrels. It is absent from the mountain regions of the Himalayas and higher norther regions of Baluchistan. Arid rocky areas with only scrub forest such as the Salt Range are also occupied by *F. pennanti*.

Palm Squirrels are widely distributed in Pakistan. They are found throughout the North West Frontier Province except in the higher mountain regions and extend from the Kurram Valley through Kohat, Bannu and Tank. In extensive sandhill desert areas such as Cholistan, Thal and Tharparkar the squirrels have penetrated wherever there is human habitation. They extend across southern Baluchistan in Mekran and have been observed in the *Acacia modesta* scrub of the Kala Chitta forest reserve where they apparently utilize rock crevices.



*Funambulus pennanti*  
Distribution Map 82 Northern Palm Squirrel or Five-striped Palm Squirrel.



Lay (1975) reports specimens from Geh in south eastern Iran, but they are not known from Afghanistan. The species ranges throughout the dryer parts of India south to about Bombay. In the more humid north eastern parts of the sub-continent it is replaced by *Funambulus palmarum*, the three striped Palm Squirrel.

The distribution of this squirrel seems to be expanding with the spread of irrigation cultivation. Though of no serious economic importance as an agricultural crop pest, it does cause damage in small flower and vegetable gardens in towns and villages.

**Biology:** *F. pennanti* is diurnal and arboreal. It readily moves on the ground and forages extensively there. The night is spent curled up inside a tree cavity or crevice in the wall of a building. In cool weather, the squirrels emerge well after sunrise and have been seen to hang head down in the sun on the vertical trunk of a tree for considerable periods.

Although this squirrel appears quite omnivorous, seeds probably form the bulk of the diet. In addition to the seeds of *Acacia arabica* and *Albizia lebbek*, the seeds of *Salvadora persica*, *Zizyphus* sp. *Citrullus colocynthis* are important dietary items (Prakash, 1959A). Leaf and flower buds and the bark of young twigs are readily consumed. In the Punjab, they have been seen to eat maize seedlings. In early summer, insects form a significant part of the diet. Prakash, (1959A) reported remains of crickets, locusts and cockroaches. Bartlett (1899) observed the squirrels eating termites and small beetles and Banerji (1955) saw them catch and eat house flies (*Physalia physalis*). The nests of small birds, i.e. the white eye (*Zosterops palpebrosa*) and little brown dove (*Streptopelia senegalensis*) are attacked and robbed of eggs.

In Pakistan, *F. pennanti* breeds throughout the year. Females probably produce three litters of two to four young each year, three on average. The female builds a rough nest constructed of jute string, cotton lint, other natural fibres and grasses. Tree holes and cavities in walls are favoured sites. Good nesting sites may be used repeatedly over a period of years. At Khanewal, a hole in a wall of an office verandah and a hollow high in a Eucalyptus tree were such regularly used sites.

The testes of the male become quite large and scrotal. Breeding of captive palm-squirrel was reported by Banerji (1955 and 1957). Females reach sexual maturity between six and eight months of age. The oestrus (receptive) period is of about 16 hours duration. Although a number of males may be attracted, the female mates with only one though a second male may be accepted. Copulation lasts for 15–20 minutes.

Gestation varies from 40 to 42 days. The male does not participate in nest building or in care of the young. After parturition the female becomes fiercely protective of the nest area. The young are born blind and naked although the longitudinal markings that are present in the adult are faintly visible. The eyes open at about 20 days of age and weaning occurs at about 8 weeks. The female exhibits post-weaning oestrus.

A captive female was observed to pluck hair from her tail with which to line her nest. Insufficient building material may have been available, but many female specimens appear to have straggly tails. This behaviour, therefore, may be general in the species.

An Indian Sparrow-hawk, *Accipiter badius* has been seen to feed on this squirrel. The Monitor, *Varanus griseus*, readily climbs trees and is suspected of preying on the young of *F. pennanti*.

Two distinct vocalizations are recognizable although others

probably exist. An alarm call is produced that is almost bird-like. It consists of three rapidly repeated whistle-like notes, 'chiterit, chiterit'. This call may be repeated monotonously for as long as 10 minutes. A tail jerk accompanies the call each time it is emitted. Once the call is elicited from one squirrel, other palm squirrels in the area take up the call and form a chorus. In addition to the alarm call the female advertises her oestrous condition by emitting a melodious call that attracts males in the vicinity.

### Genus MARMOTA Blumenbach, 1779

There are about 13 species of Marmots recognized by most authorities and they are distributed throughout the northern hemisphere. Five species inhabit North America and only one now survives as a remnant population in western Europe whilst there are six or seven Asiatic species.

All are diurnal in activity, hibernating in winter and usually living colonially. They are comparatively large thickset rodents with bushy tails and small low set ears. Two species inhabit Pakistan.

### Key to the Genus MARMOTA

Body heavy and thickset with tail short (less than half head and body length) and adapted to a terrestrial existence. Brain case of skull flattened with a heavy sagittal crest (see Fig. 62). Incisors powerful and coated with pale yellow or whitish enamel.

### Key to the Pakistan Species of MARMOTA

- (i) Tail less than one third of head and body length. Ventral fur buff or sandy coloured. Head and body length 510–670mm.  
... *Marmota bobak*
- (ii) Tail over one third head and body length. Ventral fur reddish-gold. Head and body length 500–600mm.  
... *Marmota caudata*

### MARMOTA CAUDATA

*Marmota caudata* Jacquemont, 1844; Long-tailed or Kashmir Marmot (see Illustration 67).

Subspecies *M. c. aurea* Blanford, 1875; Golden Marmot.

Synonym *Marmota aureus* Blanford, 1875

*Marmota stirlingi* Thomas, 1916

**Description:** Except for the Porcupine (*Hystrix indica*), this is the largest and most heavyset rodent inhabiting Pakistan. Male and female specimens have been collected from the Kaghan Valley weighing slightly over 4.6kg (10lb). They are considerably lighter than this in the early part of the summer when they first emerge from hibernation.

This marmot is handsomely marked, having long, though coarse hair covering all the upper part of its body. The fur is a rich golden orange colour with a mixture of black hairs in the dorsal region and the top of the head. In some specimens the mid dorsal region is solidly black as is the top of the crown. The eye is framed by a ring of black hairs contrasting sharply with the pale gold of the lower cheeks and there is an indistinct ring of black hairs around the forepart of the muzzle. The tail in this species is comparatively long and may measure more than 30cm (12in.) in length. The tail is bushy throughout its length with the tip solidly black. The belly fur is more sparse and is a more rusty orange colour than the



Illustration 67 *Marmota caudata*: Long-tailed Marmot.  
(Based on fresh killed specimen, adult male, in mid  
June, Saif-ul-Maluk, Hazara District.)

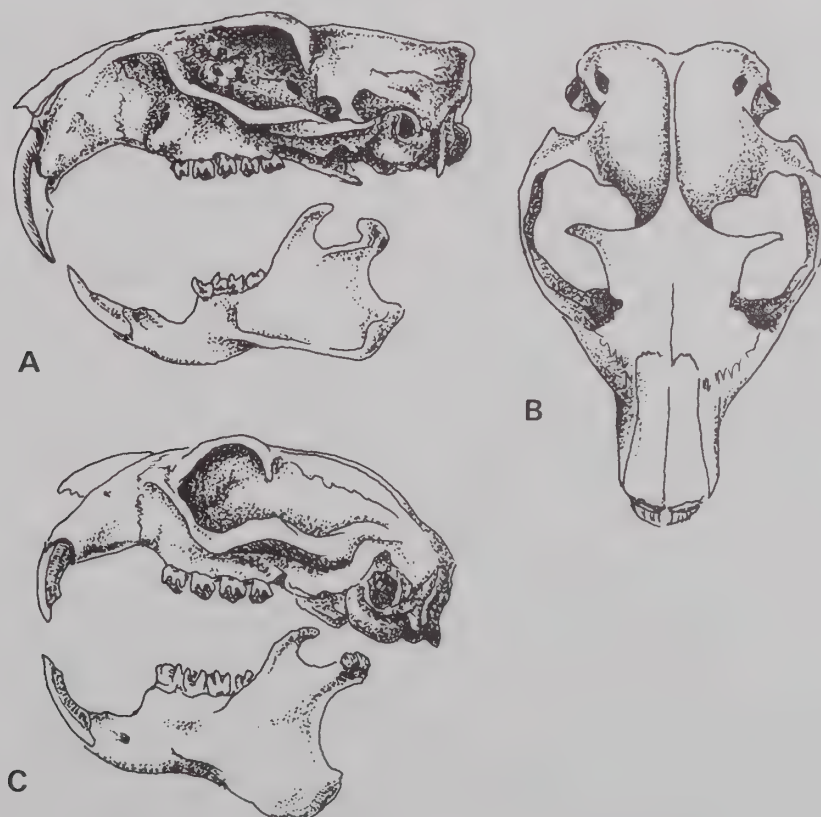


Fig. 62 Showing skulls of *Sciuridae*.  
A. Lateral view *Marmota caudata*.  
B. Same dorsal view. Note enormously powerful  
incisors with well developed sagittal crest.  
C. Lateral view skull of *Petaurista petaurista*. Note  
shorter incisors with skull lacking sagittal crest.



flanks. Adults have a long ruff of hairs extending down either side of the neck from behind the ear to the front of the chest. This ruff usually consists of paler golden hairs and is reminiscent of the hair formation along the neck of the Himalayan Black Bear (*Selenarctos thibetanus*).

In general appearance they are short limbed, bulky looking animals. The hind feet have naked black soles and they are plantigrade in gait (see Fig. 63). There are five digits on the hind feet and four on the more slender fore-feet, all armed with powerful elongated claws which assist them in digging. There is also a vestigial thumb on the fore-feet having a tiny flat nail. The skull is massive and broad with the eye set high

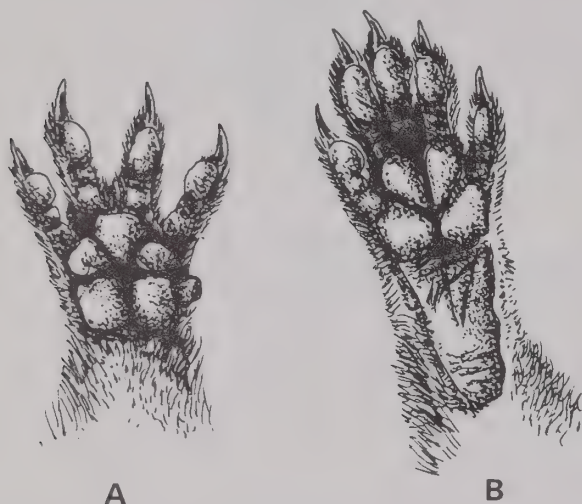


Fig. 63 Showing foot of *Marmota caudata*.

A. Right fore-paw.

B. Right hind foot.

Note vestigial thumb and long fossorially adapted claws.

up near the crown. The iris is dark walnut brown in colour. The small rounded ears are thickly fringed with hairs on both surfaces and do not protrude above the top of the skull. The muzzle is deep and broad with the upper lip divided and showing the powerful incisors. These are covered with a dull white, not orange enamel. The female has eight to ten mammae, two pairs thoracic, one isolated pair abdominal and one to two pairs located inguinally. The male has inguinal testes (carried internally). Juvenile marmots have less black hairs and a softer fur which is more greyish buff in colour. Average dimensions of nine specimens from Pakistan is as follows. Head and body length 511mm (range 456–554mm). The tail 248mm (range 213–275mm), with the ear averaging 98mm (range 90–105mm). An adult male in early June weighed 4.1kg (9lb), a lactating female weighed 6015g (13½lb) in mid July.

**Subspecies:** *Marmota caudata aurea*. The Golden Marmot is such a distinctive looking animal that when the first specimens were examined from Chitral they were described as a separate species (Thomas, 1916). They are now generally considered as a local subspecies of the Long-tailed Marmot (B. Hoffman, in lit.).

Averaging slightly smaller in size than the nominate race of the Long-tailed Marmot it is a strikingly beautiful Marmot being a bright golden or honey colour throughout the upper part of the body with practically no black tipped hairs any-

where, except around the muzzle. It lacks the grizzled appearance of *Marmota bobak* and even the mid dorsal region is bright reddish-gold. However the bushy tail is black tipped. Some specimens are more reddish than others with a tendency to traces of black hairs in the mid dorsal region.

**Distribution and Status:** The Long-tailed Marmot is confined to the alpine scrub or alpine meadow zone being found never below the tree line. It is usually found between 3200 and 4850m (10,500 and 16,000ft) in broken rocky ground interspersed with small patches of grass and other alpine vegetation. It will not be found in very arid mountain regions nor in steep precipitous cliffs.

The Long-tailed Marmot occurs in Hazara District in the northern part of the Kaghan Valley (Kunhar River) from 3200m (10,500ft) elevation up to 4250m (14,000ft) elevation. It also occurs in Chilas District of Gilgit and in Astor around the slopes of Nanga Parbat. It is extremely plentiful throughout the Deosai Plateau in Baltistan, south of the Indus River and extending eastwards to Burzil. It has also been observed in Swat Kohistan in the higher alpine valleys.

Elsewhere it extends into Uzbekistan in Russia and Paghman in Western Afghanistan. It does not occur in the rest of the Himalayan range except in the northern part of Kashmir.

**Subspecies:** *Marmota caudata aurea*. The Golden Marmot occurs in Chitral State from the western border with Afghanistan near the Dorah Pass as well as the Agram Pass further north and in the Lutko and Arkari Nullahs. Captain Fulton recorded it at the top of the Yarkhun and Ayon Nullahs as well as around Baroghil (Fulton, 1905), eastwards to the northern borders of Chitral, and into the Pamirs of Afghanistan and the Russian border. Dr. Schaller found plentiful colonies around Besti, a tributary valley of the Arkari (pers. comm., 1972).



*Marmota caudata* Known distribution

Probable range

*Marmota bobak* Known distribution

Probable range

Distribution Map 83 Long-tailed or Kashmir Marmot. Himalayan or Bobak Marmot.

The skin of the Long-tailed Marmot is of little value since the fur in summer is rather coarse. Since they sometimes form very large and extensive colonies, they do compete during the brief summer season with nomadic sheep and goat flocks for the limited forage which is available at these high altitudes. Even in the remotest alpine valleys grazing flocks are driven up to 4850–5200m (16,000 to 17,000ft) elevation and there is plenty of evidence of over grazing and even erosion caused by such flocks at this elevation particularly in the vicinity of camp sites.

**Biology:** This marmot is gregarious, living always in colonies though these may be widely scattered. They excavate extensive underground burrow systems, and commonly their burrows commence underneath a large boulder or overhanging rock with a large rounded mound of well trampled earth encircling the mouth of the burrow. In the rocky terrain which they frequent it is difficult for a man to try and excavate such burrows, but they appear to be both deep and extensive, with more than one entrance passage in most cases. Some of these entrances slope quite gradually and others appear to descend almost vertically into the ground. It is known that they excavate large chambers underground in which they sleep and the females produce their young. Sometimes they live exclusively in regions of rock talus, utilizing natural rock crevices in which case there is not much evidence of soil excavation.

They are diurnal and generally emerge shortly after sunrise to feed during the summer months. They are exclusively herbivorous but will feed on a wide variety of grasses and herbaceous plants. In fact in the Kaghan Valley, they will dig the bulbs of wild lilies (*Eremurus* spp.) and in Russia they have been recorded as feeding on chicory and *Artemisia maritima* (Ognev, 1947). They use their front paws to hold plant stems and bulbs and convey food to their mouth. In contrast to many related ground squirrels and vole species inhabiting mountain regions in central Asia there is no evidence that this marmot collects or stores any food underground. However in the spring and early part of the summer they spend long hours above ground feeding. Later in the summer they are less active in feeding and by this time have built up considerable sub-cutaneous fat reserves. During the latter part of the summer it has been observed that marmots will not emerge above ground at all to feed on days when it is raining or when the weather is very dull and cloudy. According to S. I. Ognev (1947) older animals may even stay underground in their burrows for three or four days at a stretch in August and September.

No detailed studies have been conducted upon the behaviour of this marmot, which is surprising considering their diurnal habits. In the early part of the summer (late May) I have observed that they often appear quite playful or quarrelsome, chasing each other and actually scuffling together at the mouth of a burrow. In one case of apparent fighting between two Long-tailed Marmots of undetermined sex one individual appeared deliberately to throw dirt backwards onto its opponent by scratching with its hind feet. One of the most striking characteristics of marmot behaviour is their vigilance in the presence of human intruders or other danger. Their ringing alarm call is usually heard long before any individual animal can be sighted. This consists of a loud almost bird-like whistle which indicates warning of an intrusion rather than panic and it can best be syllable-ized 'Bree Bree'. Marmots will not flee when such a whistling call is made by one of the colony; they merely become alert. If marmots see anything suspicious whilst feeding they at once

sit upright on their haunches to get a better look. They may climb onto a rock for better vantage and may remain motionless on such a rock until the danger has passed. Though marmots have short legs and look decidedly clumsy when running over open ground they can jump considerable distances up boulders and seem to be particularly swift when scampering over rocks. I have also observed an individual marmot at the mouth of its burrow drumming the ground with its hind feet in a similar manner to Desert Jirds (*Meriones hurrianae*). This would appear to be a more urgent warning than their whistle alarm, given when danger is closer and perhaps serving to warn other members still underground. Another characteristic marmot gesture is in the flicking upwards of the tail, usually just before or after jumping from one rock to another.

Very little is accurately known about the breeding biology of any of the alpine marmots. It is probable that they are monoestrous (see Armitage, 1962) and that females in their first spring (when 11 to 11½ months of age) do not come into oestrus condition. The adult females, however are oestrus just after emergence from hibernation in May at which time the marmots are sexually active. Only one litter a year is produced which may vary from two to four occasionally up to five or six. In one colony of some 50 individuals in Buruwai, Kaghan Valley, I observed five litters of which three comprised 3 young and two 4 young in mid July. The gestation period is thought by some authorities to be about 40 days (Walker et al., 1964) but I consider it is more probably 30 days, like its congener the Woodchuck (*Marmota monax*) which has been more closely studied. The young are first observed above ground in early July at which time they are believed to be four or five weeks old. Young observed in the Kaghan Valley at 12,000ft elevation on 8 and 9 July were quite active, foraged on green vegetation some distance from the burrow mouth and appeared to be at least five or six weeks of age. A pet spaniel of mine caught a baby marmot near Burzil in the second week of August and its small size suggested that it must have been about two and a half months old.

The Long-tailed Marmot undergoes a very long hibernation since the regions where they live often have their first fall of snow early in October. Marmots have been observed still active on September 30th above Saiful-Maluk in Hazara District, but in most years they probably start hibernating within the first seven or eight days of October and colonies at higher altitudes do not emerge until early or even mid May, since very little exposed ground is revealed by melting snows until the end of May in some of the regions inhabited by this marmot. Thus they may be considered to be active for hardly 4½ months of the year. There is evidence for believing that marmots congregate in groups of 10–15 individuals whilst hibernating, huddling together in one subterranean chamber. This is true hibernation, since studies in Russia have confirmed that their body temperatures drop often to freezing and that they do not emerge at any time during the winter as is the case with some partially hibernating species. Before hibernation they seal the exits of their burrows with a plug of earth and grass. During hibernation fat reabsorption probably takes place though this may be quite limited since the metabolic processes are much slowed down. Since females breed immediately after hibernation it is probable that some of the fat reserves last until after they emerge in the spring and are utilized by males and females during this sexually active period.

Anyone who has handled a wild caught marmot will be struck by the number of ectoparasites infecting the body fur. Marmots can frequently be seen scratching themselves with their hind feet and their fore-paws. Possibly their habit of



hibernating in close physical association and their continuous use of the same underground nest chambers favours the multiplication of such ectoparasites. Some Asiatic species of marmots are potential vectors of Bubonic Plague. In the Kaghan Valley marmots were found to be infected with fleas (*Ceratophyllus* spp.) and lice (*Neohaematopimus* spp.).

Despite a heavy incidence of parasites marmots are fairly long lived rodents. Long-tailed Marmots lived for six years in the London Zoo (Dover, 1933) and a captive Himalayan Marmot lived for fifteen years in Russia (Ognev, 1947). The most dangerous predator of the Long-tailed Marmot is probably the Golden Eagle (*Aquila chrysaetos*), which in Pakistan haunts exactly the same alpine meadows. S. I. Ognev (1947) records finding the remains of marmots in a Lammergeier's (*Gypaetus barbatus*) eyrie. In the Wakhan region of northern Chitral, Khirgiz shepherds graze their flocks in the vicinity of Long-tailed Marmot colonies, and it has been observed that the shepherds' dogs in such regions become very clever at lying in wait near occupied burrow entrances and capturing the marmots on which they subsist (Lt. Col. Khush Wakht, pers. comm.). No doubt wolves (*Canis lupus*) and Snow Leopards (*Panthera uncia*) also succeed in preying on marmots in the summer months. One observer in the Pamir mountains where the Long-tailed Marmot occurs, noted that if an individual was caught far from its burrow it had the habit of shamming death (Le MBA, 1900A). This habit does not appear to have been recorded by other observers.

#### MARMOTA BOBAK

*Marmota bobak* Müller, 1776; Himalayan or Bobak Marmot.

**Description:** This marmot is about the same size as the Long-tailed Marmot, perhaps averaging slightly larger. It can be distinguished by having a comparatively shorter tail and in being not so brightly coloured, with shorter harsher body fur. It lacks the golden-orange tones of the Long-tailed Marmot being more of a sandy-brown colour with black-tipped hairs scattered throughout and not forming any solid black dorsal region as in the case of the Long-tailed Marmot. The top of the head is also not markedly blacker nor is there any distinctive outer ring of black hairs around the eyes. In fact the general tone of the face is darker brown than the rest of the body with a pale buff orbicular ring. Its belly fur is very scanty and buff in colour. The ears are small and rounded and thickly fringed with hairs on both surfaces. The broad incisors are coated with white enamel. The tail is black tipped and rarely measures more than 15 cm (6 in.) in length. A specimen collected just north of Skardu in Baltistan had the head and body length 61 cm (24 in.) with the tail 17.8 cm (7 in.), the hind feet 10.2 cm (4 in.) and the ear 3.1 cm (1½ in.). This was a particularly large male and the head and body length of three specimens in the Bombay Natural History Society collection from Ladakh (India) varied from 46 to 51 cm (18–20 in.) in length.

Like the Long-tailed Marmot, juveniles have softer more greyish-buff fur.

The Bobak Marmot has slightly developed cheek pouches and this feature is in fact shared with all the marmot species.

**Distribution and Status:** This Marmot is adapted to alpine desert conditions and areas of very low rainfall. In the moist alpine meadows with some monsoon influence, it is replaced by the Long-tailed Marmot. It occurs only in the northern part of Baltistan in Pakistan and very little is

known about the type of habitat preferred by this species in this region. In central Asia the Bobak Marmot is characteristically found in broad steppic plains but in the Karakoram range it must frequent more rocky mountainous regions.

The Bobak Marmot does not occur south of the Indus River in Pakistan territories and appears to be confined to the northern part of Baltistan (see Distribution Map 83). Specimens have been collected from Skardu.

Extra-limally it extends right across the inner Himalayan regions of India to Nepal and Sikkim. It also occurs throughout Tibet and extends to Russia into Kazakhstan and the Altai. It has not been recorded from Afghanistan.

With the northern frontier regions of both Pakistan and India having been forbidden territories for a number of years to foreigners, there is very little information available which might indicate the distribution of the two marmot species *M. caudata* and *M. bobak* inhabiting the inner Himalayan ranges. It is not known where they converge and whether they have distinct ecological preferences which would account for their present pattern of distribution. Nothing has been recorded about the distribution or economic status of the Bobak Marmot in Pakistan.

**Biology:** Although there are no recorded observations about the Himalayan population of this marmot, Russian authorities have made a number of observations on the population living in the high plateau steppic regions of central Asia (Bobrinskii et al., 1965 and Sokolov et al., 1963).

Like the Long-tailed Marmot they are colonial and diurnal in feeding activity. In Russia they appear to prefer level ground for burrowing. In such terrain their burrow is marked by a conspicuous rounded mound of earth often about 0.6 m (2 ft) in height. The Bobak Marmot is very fond of sunning itself on this mound assuming a characteristic pose with both fore and hind limbs spreadeagled and the belly pressed close to the ground. They feed on a wide variety of grasses and herbs. In Russia they have been recorded as feeding on the bulbs of wild onions (*Allium* sp.) and to be characteristically associated with steppic plains having scattered bushes of *Sisymbrium sophia* (Ognev, 1947). Presumably in Pakistan they are associated with more rocky alpine areas. They are equally wary and alert in the presence of human intruders and have a similar loud ringing alarm call as *M. caudata* but this call has been described as being less melodious than that of *M. caudata* and has been syllable-ized as 'ku-khee' (Ognev, 1947).

Judging from young specimens in the collection of the British Museum from Himalayan regions the young are born in the early summer from late May to June and Prater (1965) gives the litter size as two to four. S. I. Ognev (1947) records litters of up to nine young in this species in Russia. The young are born blind in an underground nest chamber, and they are probably suckled for about one month as in other Marmot species. The females are not believed to be sexually mature until their third summer (Walker et al., 1964). The Bobak Marmot also hibernates for at least 7½–8 months in the Himalayan regions, and it is believed that a number will congregate together sharing a single burrow during hibernation. S. I. Ognev records that they excavate trenches in which they regularly deposit their faeces early in the summer but that later these latrine trenches do not appear to be used and possibly they deposit their faeces underground and use this to mix with earth in sealing the burrow entrance before hibernation (Ognev, op. cit.).

They are probably preyed upon by wolves (*Canis lupus*)

which are more plentiful in these northern regions, as well as by Golden Eagles (*Aquila chrysaetos*).

#### FAMILY HYSTRICIDAE — PORCUPINES

##### Key to the Family HYSTRICIDAE

There are generally considered to be four genera of Porcupines within the Family *Hystricidae* all of which inhabit the old world including Africa, the Mediterranean and extending to tropical South East Asia.

Dental formula: incisors 1/1; canines 0/0; pre-molars 1/1; molars 3/3.

Fur modified into quills or spines. Five hind toes. Skull massive with cheek teeth hypsodont and upper incisors orange-brown. Infra-orbital foramen of skull very pronounced and tympanic bullae relatively small (see Fig. 64). The tibia and fibula are separate.

##### Genus HYSTRIX Linnaeus, 1758

The Genus *Hystrix* includes 12 species usually referred to as Crested Porcupines because of the presence of very long stiff bristle-like hairs along the neck and upper back region. Probably the trivial name 'porcupine' refers to their rather large size and grunting voice.

##### Key to the Pakistan Species of HYSTRIX

Massive size. Head and body 640–740mm. Tail very short and clothed with short hollow white quills. Crest of long black spines on crown and neck well developed.

... *Hystrix indica*

#### HYSTRIX INDICA

*Hystrix indica* Kerr, 1792; Indian Crested Porcupine (see Illustration 68).

Synonym *Hystrix leucura* Sykes, 1813; Russian Crested Porcupine.

**Description:** This is the largest rodent found in Asia with the exception of the beaver (*Castor fiber*) of the far northern boreal zone. Adult male specimens frequently reach 11.3kg (25lb) in weight and A. A. Dunhar Brander (1931) describes digging four porcupines out of one burrow all of which weighed over 18kg (40lb) and measured 89cm (35in.) from nose to tail. R. W. Burton (1915) records a specimen weighing 15kg (33½lb). The porcupine is a thickset rodent with short powerful limbs having four digits on the fore-feet and a vestigial thumb. There are five digits on the hind feet and they are plantigrade in gait, the sole of the hind foot being naked. Each digit terminates in a very powerful long claw which assists them in digging. The head terminates in a broad blunt muzzle, the upper lip being divided and the area around the nose appearing rather fleshy. The eye is comparatively small considering the nocturnal habits of this species. The ear is also relatively small, consisting of a comparatively shallow circular pinna. The vibrissae are generally all black and the longest measures up to 20cm (7¾in.) in length. The lower part of the body is thinly clad with dark brown and black rather short bristle-like hairs. These are usually highly glossy and the face is also covered with short brown bristle-like hairs with the naked black skin showing through, particularly in the region of the shoulders, belly and muzzle. There is an indistinct crescentic pattern of grey and white bristles extending from in front of the shoulder and across the chest. From the fore part of the crown to behind the shoulders the hairs on the top of the body are modified into very long

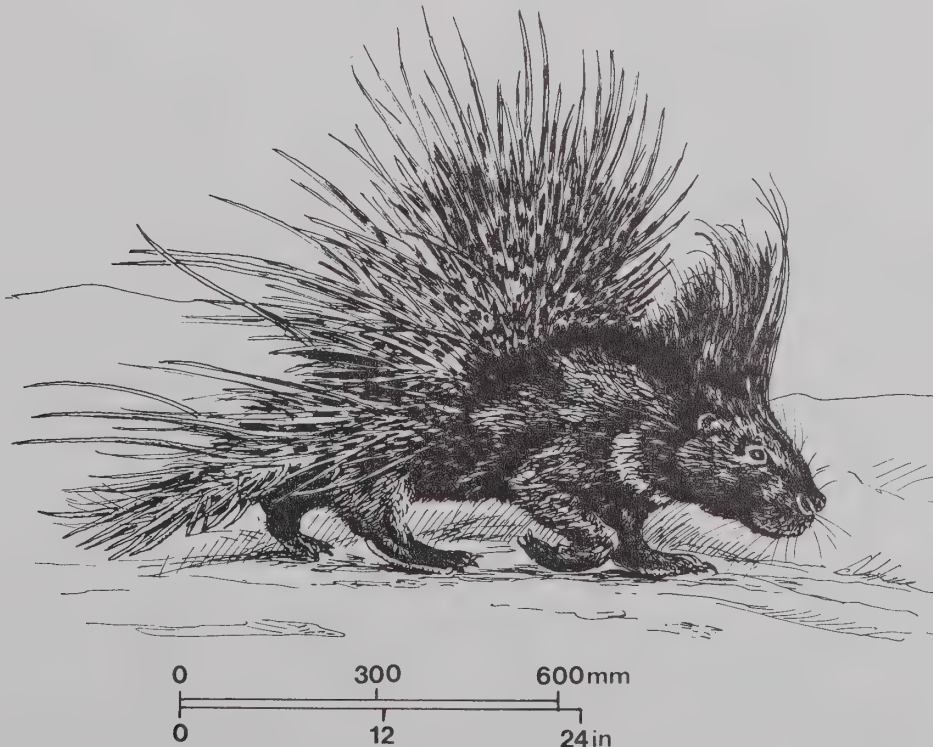


Illustration 68 *Hystrix indica*: Indian Crested Porcupine.  
(Based on captive specimen adult male, collected December in Pirawala Forest Plantation, Punjab.)



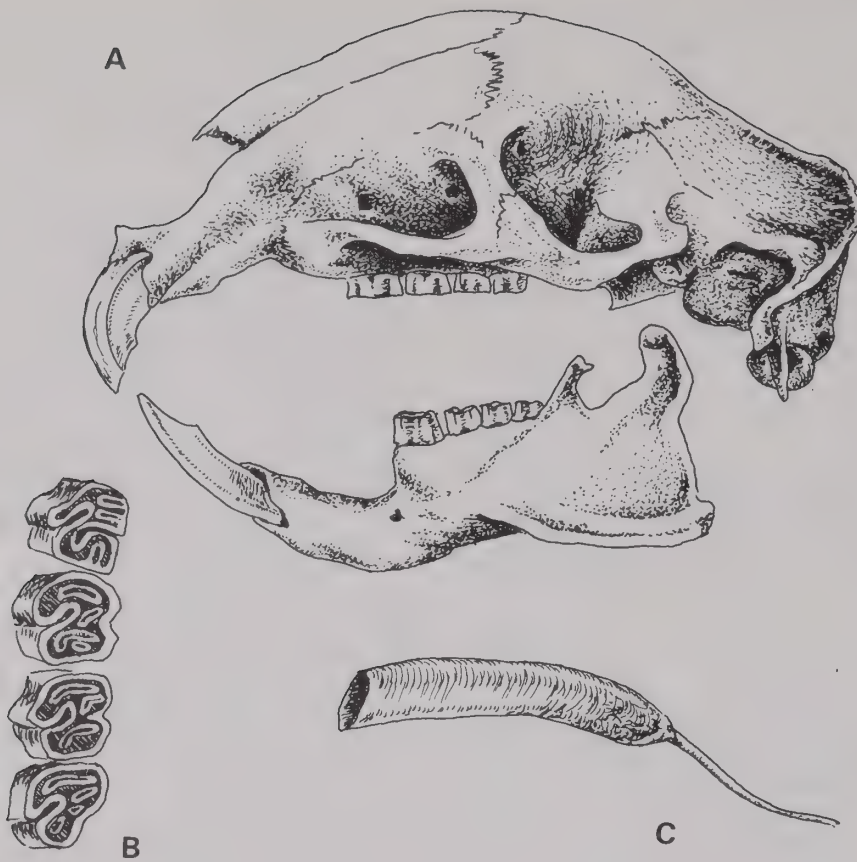


Fig. 64 Showing features of *Hystrix indica*.

- A. Lateral view of skull and mandible. Note strongly developed incisors and also sagittal crest.  
 B. Left upper maxillary tooth row. Note alternating

bands of enamel and dentine.

- C. Modified hollow tail quill. Note filamentous portion on right which forms point of attachment of quill to the tail.

slender spines generally of an all black colour and measuring up to 35.5cm (14in.). These spines can be erected in the form of a prominent crest when the animal is excited or angry. From the mid dorsal region and down the lower flanks the hairs are further modified into the well known porcupine quills. These consist of very stout hollow spines terminating in extremely sharp points which are characteristically banded alternately with black and white. The longer quills generally have white tips and the thickest quills are located on the lower flanks and the region of the hind quarters. The longest quills on the lower flanks measure about 20.4cm (8in.). They bear fine longitudinal ridges or striations on their surface and are very loosely connected to the skin so that they are easily dropped or shed. The tail is quite short, rarely more than one-fifth of the head and body length, and clothed with modified quills which are generally all white in colour, very short and broad being attached to the body by needle-like points. These short quills are open ended (see Fig. 64) and when the animal wishes to warn off an enemy it produces a rattling or rustling noise by quivering its tail quills not unlike the warning of a rattle-snake. The female has six mammae and these are situated along the lower flanks instead of under the belly as is the case with all other rodents. This makes it possible for the baby porcupines to suckle whilst the mother is standing or lying on her belly. The long spines would no doubt make it difficult for an adult porcupine to lie on its side especially in the confined limits of an underground burrow.

The incisors are extremely broad and powerful, being coated with pale yellow enamel. There are four grinding

teeth in each jaw which are partly open rooted and high crowned (see Fig. 64). Dimensions of five specimens from the Punjab and Sind are as follows. Head and body length averaging 632mm (range 460–715mm) with the tail 106mm (range 93–170mm), the ear 40mm (range 35–46mm) and the hind foot 89mm (range 85–100mm).

**Distribution and Status:** This porcupine is remarkably adaptable ecologically and is found over most parts of Pakistan. It occurs in steppic mountain regions of Baluchistan up to 2750m (9000ft) elevation. It is found in sandhill desert areas, as well as in the Himalayas in moist temperate deciduous forest. They have adapted themselves to live in irrigated forest plantation in the Indus Plain and they are only completely absent from well settled and intensively cultivated tracts.

It is more plentiful in areas with broken rocky hillsides and is much less common in the alluvial plain and comparatively rare in the irrigated canal colonies. It is common in Las Belas, the Kirthar Range, throughout the valleys of Baluchistan and into the outer hills of the Himalayas. I have seen its fresh faecal pellets at 2500m (8500ft) elevation in Baluchistan. It occurs commonly in the Salt Range, throughout the Murree Hills and Hazara District even up to 2550m (8650ft) elevation in the forests above Shogran. Due to lack of suitable food it is comparatively rare, but does occur in extensive sand-dune areas. It is found in the main valley of lower Chitral as well as in the Vale of Swat. It occurs around Bannu and in the Kurram Valley.



Distribution Map 84 Indian Crested Porcupine.

The Crested Porcupine seems well able to hold its own even with the increase in human population and gradual destruction of wilderness areas. Cultivation of crops such as sugar-cane, and the creation of irrigated forest plantations may even have fostered its spread and increase in the Punjab. It is considered a serious economic pest by the Forestry Department, and the Chief Conservator of Forests in Multan region, for example, offered a bounty of two rupees for each animal killed in 1971. It is common in Baluchistan and occasionally does serious damage to orchard fruit trees, gnawing off the bark and even cutting right through the tree bole. There are some aboriginal tribes of people in Sind who hunt the porcupines for food and its flesh is considered a great delicacy (Eates, 1968). In contrast to some North American and African tribes of people, there is no evidence that porcupine quills were ever used in this region for decorating various artifacts or articles of daily use.

**Biology:** F. W. Champion (1927) describes the porcupine in Himalayan hill stations as being far from nocturnal in habits but it seems to be strictly nocturnal wherever I have encountered it in Pakistan. In fact it seems to be a very cautious and shy rodent, emerging from its burrow only well after dark. Porcupines generally dig their own burrows and these can be very extensive, with numerous side entrances and descending to considerable depths underground. S. H. Prater (1965) describes one such burrow which extended for more than 18.5m (60ft). Often two or three individuals appear to share the same burrow system and they will occupy such a burrow for several years if not disturbed. They appear to be partly social in living habits. One such burrow system under observation in Pirawala Forest Plantation has been continuously occupied for a four year period since it was first discovered, and this despite two animals from this burrow having been trapped and destroyed. Porcupines often excavate their burrows in the embankments of old river channels.

Porcupines are herbivorous, but prefer the bark of certain

tree species and also certain roots, bulbs and succulent tubers. They will also feed on ripe fruit. In Baluchistan they regularly excavate the bulbs of *Eremurus aurantiacus*. In the south west Punjab they appear to prefer the bark of the Persian Lilac (*Melia azedarach*) and will systematically attack this tree in a forest plantation. Their second preference seems to be the mulberry (*Morus alba*) and thirdly the mango (*Mangifera indica*). Trees with thick and rough bark seem to be shunned. They are also very destructive of agricultural crops and do extensive damage to maize crops and occasionally sugar-cane in the Punjab. They also show a fondness for potato and sweet potatoes as the tubers are maturing. In Kalat State and southern Baluchistan they are notorious for stealing ripe melons. In fact they seem to know just when a fruit or vegetable is ripe and ready for picking, as F. W. Champion has commented (1927), and have an infuriating habit of stealing such fruit on the night before the farmer or gardener has decided to harvest the crop.

Porcupines will wander over considerable distances in their nightly foraging and in the south west Punjab I have seen their fresh tracks in regions at least three miles from the nearest known occupied earth. It has been reported by some observers that porcupines carry bones and shed deer antlers to their burrows and have the habit of gnawing these. Perhaps they obtain minerals necessary for quill development thereby.

Porcupines produce very characteristically shaped elongated faeces, often in clusters, and these readily betray their presence (see Fig. 85).

Females often excavate a separate burrow in which they produce their young and in the Indus plains this may be dug in a thicket of tall grass or a sugar-cane crop. The gestation period is comparatively prolonged, about 112 days. Generally two to four young are born and they are well developed at birth and have their eyes open. The spines are comparatively short and quite soft for the first few days. S. H. Prater (1965) states that the male porcupine may often share the same burrow where the young are born. In Khanewal region litters generally seem to be produced in February and March and it is not known whether a second litter in the year is produced. Observations on captive porcupines indicate that the young remain for several months with the mother and are comparatively slow growing. The Crested Porcupine in the Mediterranean region has been recorded as producing two litters in a year.

Porcupines are well protected against predators yet they appear to be a favoured food amongst many of the larger carnivores. There are many authentic records of both tigers and leopards being fatally injured from a porcupine's quills. When threatened with danger the porcupine will often erect its quills and rattle them together as well as making grunting noises. If the potential attacker does not heed these warnings, it then often runs rapidly backwards or sideways into the aggressor. Its quills are immediately shed if they become impaled on any object. Despite the warning rattle of its hollow tail quills, and awesome protective spikes, many carnivora seem unable to resist the temptation to attack. Dogs become wildly excited in the presence of a porcupine and I have seen bull-terriers with terrible injuries about the throat and chest. The old belief that a porcupine can actually shoot out its quills at an aggressor is of course without foundation. A captive specimen, when placed inside a wire-netting enclosure, charged sideways with surprising speed whenever any person approached the netting and would have inflicted severe injuries. When finally released, though it appeared clumsy in gait, it was capable of outpacing a running man. Porcupines are preyed upon by Leopards (*Panthera pardus*) and Hyenas



(*Hyaena hyaena*) and probably Wolves (*Canis lupus*), but in the more settled tracts they appear to have few natural enemies.

A captive specimen has lived for 20 years, but in the wild they probably do not survive for more than eight to twelve years.

#### FAMILY DIPODIDAE — BIRCH MICE, JERBOAS

Ellerman and Morrison-Scott in their Checklist (1951) placed the Birch Mice along with the Jerboas, and the Jumping Mice into one family Dipodidae. Many Russian authorities as well as the majority of American systematists prefer to separate the Birch Mice into a distinct Family Zapodidae leaving the Jerboas in the Family Dipodidae (for example, Bobrinskii et al., 1965; Flint et al., 1965; and Anderson and Jones, 1967).

There are four genera in the *Zapodidae* inhabiting North America, Europe and Central Asia. They have poorly developed internal cheek pouches, very long tails and often elongated hind-feet modified for jumping. There are 10 genera in the Dipodidae inhabiting North Africa and south western Asia, mainly in semidesert or steppic regions. They are remarkably adapted for a saltatorial mode of progression with the hind legs greatly elongated and the fore-legs almost vestigial.

#### Key to the Family DIPODIDAE

Dental formula: incisors 1/1; canines 0/0; pre-molars 1/0; and molars 3/3.

A diverse family with some members highly adapted to a saltatorial gait. The cheek teeth are rooted and usually cuspidate and the infra-orbital foramen is greatly enlarged and the zygomatic plate is narrow and nearly horizontal. Tibia and fibula are fused with the fibula reduced and thread-like.

#### Key to the Pakistan Species in the Family DIPODIDAE

1. A. With distinctive cranial characteristics. Infraorbital foramen greatly enlarged and zygomatic plate narrow and completely beneath infraorbital foramen. Tail slender, without any terminal pencil or tuft and about 140 per cent of head and body length. Mouse-like in form. Hind leg not greatly elongated.  
... *Sicista concolor*
- B. Tail with conspicuous terminal tuft. Body highly modified for bi-pedal gait with elongated hind legs and much reduced fore-legs.  
... 2
2. A. Hind foot with five toes (though outer toes much reduced). Long hare-like ears.  
... *Genus Allactaga*, 3
- B. Hind foot with only three toes. Ears rounded or medium length.  
... 4
3. C. Smallest size. Ear 32–36mm. Hind foot 50–60mm. Tip of tail brush feather shaped and flattened dorso-ventrally.  
... *Allactaga elater*
- D. Medium size. Ear 44–46mm. Hind foot 57–59mm. Tip of tail brush rounded and not very pronounced or extensive.  
... *Allactaga botsoni*

- E. Largest size. Ear 50–52mm. Hind foot 62–68mm. Tip of tail brush rounded and with extensive black area preceding white tip.  
... *Allactaga williamsi*
4. A. Very small size. Hind foot 18–19mm. Terminal tail tuft brown and not very conspicuous. Ear rounded and about 9mm long.  
... *Salpingotus michaelis*
- B. Rat-sized with terminal tail tuft conspicuously contrasting black and white. Hind foot 68–72mm. Ear elongated and about 25mm long.  
... *Jaculus blanfordi*

#### SUBFAMILY SICISTINAE

##### Key to Subfamily SICISTINAE

Three central metatarsal bones not fused together to form a cannon-bone. Hind foot with five functional hind toes and not modified to a saltatorial life. 4 to 3 cheek teeth which are biserially cuspidate.

#### Genus SICISTA Gray, 1827

This genus comprises the Birch Mice which inhabit temperate regions of the Old World. There are six species extending from the European Arctic to China. They can climb well and spend a large part of their time clambering in thickets and low bushes aided by their tails which are partly prehensile. Unlike the other *Dipodidae* which are saltatorial, the *Sicistinae* are quadrupedal in gait.

#### Key to the Genus SICISTA

Small size (head and body length 50–80mm) with Murine (mouselike) form and slender tail longer than head and body.

#### Key to the Pakistan Species of SICISTA

Without any dark stripe running down the back. Head and body length 63–75mm with tail about 140 per cent of head and body length. Upper lip not split.  
... *Sicista concolor*

#### SICISTA CONCOLOR

*Sicista concolor* Büchner, 1892; Chinese Birch Mouse (see Illustration 69).

Synonym *Sminthus leathemi* Thomas, 1893.

*Sicista tianschanica* Salensky, 1903.

**Taxonomy:** Ellerman and Morrison-Scott (1951) treat *Sicista concolor tianschanica* as a subspecies and recent Russian authors also consider *tianschanica* as a subspecies of *S. concolor* (Bobrinskii et al., 1965).

**Description:** Most of the species within the Genus *Sicista* have a mid dorsal conspicuous dark stripe as well as a proportionately much longer tail than other *Muridae*. The Chinese Birch Mouse, however, as its scientific name implies, is uniformly coloured greyish-drab fawn colour, without any dark line running down the spine. Its tail averages nearly one-and-a-half times the head and body length and is comparatively well covered with short hairs and tends to be bi-coloured being whitish on its ventral surface and darker



Illustration 69 *Sicista concolor*: Chinese Birch Mouse.  
(Based on study specimens in Smithsonian National  
Museum, USA, from Kaghan Valley Hazara District.)

grey dorsally. It is capable of twisting its semi-prehensile tail around twigs and stems to assist in balancing and climbing. The upper incisors are covered with orange enamel, and are ungrooved. The lower incisors have white enamel. The molar tooth row is cuspidate (see Fig. 67). The ears are rounded but not especially large and their outer margins do not meet at the base as is characteristic of the related Jerboas. The belly fur is dull greyish-white and not sharply divided from the flanks which are pale greyish-fawn, almost a straw colour. Though it is nocturnal its eyes appear relatively smaller for example than *Apodemus* species. The hind foot is quite strongly developed, being over a quarter of the total head and body length. It bears five digits with strong claws but the fifth toes and the hallux are markedly shorter. The fore-feet have four well developed digits, the thumb or pollex being rudimentary and clawless. The soles of the feet are naked. Dimensions of 12 specimens from Gilgit and Hazara District, are as follows. Average head and body length 70mm (range 63–80mm), with the tail average 109mm (range 104–117mm), the hind foot average 20mm (range 18–28mm) and the ear 14mm (range 12–15mm). Specimens from the north west Himalayas average distinctly larger in size than the common House Mouse (*Mus musculus*). The female has four pairs of mammae.

**Distribution:** This mouse may be found from the alpine and sub-alpine scrub zones in the Himalayas, as well as in artemisia steppe, and descending to grassy slopes on the edge of forests in moister mountain regions. It will inhabit fields of terraced cultivation in the upper slopes of valleys in Gilgit.

It has been collected from as low as 2140m (7000ft) elevation in Gilgit and up to 4000m (13,000ft) in Hazara District. It appears to need mesic conditions and in the northern dryer Himalayan ranges will not be found in the broader valleys where semi-desert conditions prevail.

It appears to be sympatric with *Apodemus sylvaticus* in the moister northern Himalayan regions of Hazara but is less common and more locally distributed in Gilgit and its status or occurrence is yet to be confirmed in Chitral or Dir. It is abundant in the northern part of the Kaghan Valley. It does not occur in the Murree Hills. It occurs around the slopes of Nanga Parbat as well as in Chilas District of Gilgit. Extraliminally it occurs in Chinese Turkestan, Ladakh and Indian Kashmir as well as Russian Tianshan and the Altai.

Being confined to high altitudes where there is only marginal cultivation, it is not of great economic importance, moreover, it is never as numerically abundant as *Apodemus sylvaticus* in the same area. However, it may inflict slight damage to potato and maize crops in such northern areas.

**Biology** The Chinese Birch Mouse like all members of the genus, is extremely hardy, and capable of living in very cold regions. They are mainly nocturnal in activity but will also forage during daylight hours according to Russian observers (Bobrinskii et al., 1965). This is the only member of the Order *Rodentia* found in Pakistan which has a semi-prehensile tail. They eat mainly berries, wild fruits and seeds and their sharply cuspid molars are well adapted to cracking hard seed coats. They have been observed gnawing maize cobs





Distribution Map 85 Chinese Birch Mouse.

and have been trapped in ripening maize fields (University of Maryland Expedition). They also eat any insects which they can encounter and have been observed feeding on grass stems (Ognev, 1948).

Not much is known about its breeding habits in Pakistan but the Russian population produces litters averaging from three to six, and pregnant females were predominant in June (Ognev, 1948). They are believed to breed once only during the summer months. Male specimens have also been seen to have enlarged testes in June and to be in breeding conditions (Ognev, 1948). A female trapped on 24 July in northern Kaghan had four embryos in the uterus and another female trapped on 27 August was lactating. E. Walker (1964) gives the gestation period for all members of this genus *Sicista* as from 4 to 5 weeks. The female constructs a nest in which the young are born which is a neatly woven ball of grasses and other fibrous material. This is generally concealed in a rock crevice or under the roots of some bush. The young stay with the mother until they are about four weeks old by which time they are nearly adult size. Z. B. Mirza (1970) records that a captive specimen from Chitral bred twice during the course of one summer, each time producing a single offspring. However there are no Chitral specimens in the extensive University of Maryland collection of this species from Pakistan. It is probable that in Pakistan litter sizes vary according to the amount of rainfall and the availability of food, with two litters being produced in years of good rain.

The Chinese Birch Mouse undergoes prolonged hibernation in winter and digs its own underground burrows. In the autumn it accumulates a subcutaneous layer of fat in preparation for this hibernation (Ognev, op. cit.).

In captivity Birch Mice do well, as they are very hardy. They have a high-pitched whistle-like call. It has also been observed from captive specimens that they can go without food for prolonged periods without suffering any harm (Walker et al., 1964). Birch Mice are preyed upon by Stoats (*Mustela erminea*), Altai Weasels (*Mustela altaica*) and presumably by Stone Martens (*Martes foina*). They are probably

also preyed upon by the Rock-horned Owl (*Bubo bubo turcomanus*) which occurs in the same areas.

#### SUBFAMILY CARDIOCRANIINAE

The Dwarf or Pigmy Jerboas are confined to the Desert region of Central Asia. All are very small in size with short ears and their tails lack any conspicuous terminal tuft. There are now four species recognized, of which three are found only in Russian territory. *S. michaelis* appears to be the smallest species (Vorontsov and Smirnov, 1969).

#### Key to the Subfamily CARDIOCRANIINAE

Very small Jerboas adapted to a saltatorial mode of progression with comparatively large head and short truncated muzzle. Ears small and tubular. Hind limbs either five or three-toed and with no metatarsal fusion, the three central foot bones being separate. Shape of skull very characteristic with greatly inflated tympanic bullae fused into inflated mastoid bullae.

#### Genus SALPINGOTUS Vinogradov, 1922

Hind feet with three toes and with brush of stiff hairs on underside of hind feet. Tail with slight tuft of longer hairs at tip and tendency for adipose tissue to be deposited in proximal region.

#### Key to the Pakistan Species of SALPINGOTUS

Very small size. Head and body 36–47 mm. Tail approximately 85mm with terminal tuft comprising dark brown hairs.

... *Salpingotus michaelis*

#### SALPINGOTUS MICHAELIS

*Salpingotus michaelis* Fitz Gibbon, 1966; Pigmy Jerboa or Dwarf Three-toed Jerboa (see Illustration 70).

**Description:** Dwarf Jerboas of the *Salpingotus* Genus can be distinguished from the similar Genus *Cardiocranius* in having only three toes whilst the latter has five toes. *Salpingotus michaelis* is a diminutive Jerboa adapted to a saltatorial mode of progression. Its tiny short fore-limbs are hardly developed whilst the hind limbs have greatly elongated metatarsals. The fore-limbs have four digits but the whole limb is so small that in a typical adult specimen it measures only 9mm ( $\frac{3}{8}$ in.) from the tip of the longest digit to the elbow. The head seems comparatively large and dome-shaped in comparison to the rest of the body of this Jerboa. The muzzle is short and most of the skull is taken up by enormously inflated mastoid and tympanic bullae. The upper incisors are ungrooved and coated with white enamel. The vibrissae are very long in relation to the rest of the animal and measure up to 45mm ( $1\frac{3}{4}$ in.), whilst the dimensions of four specimens from Nushki are as follows. Head and body length 44mm (range 41–45mm), tail average 80mm (range 72–94mm), hind feet average 19mm (range 18–19mm) and ear average 9mm (range 8–11mm). The small rounded ear is set rather low down on the skull with the outer margins joining in a complete circle so that the pinna actually forms a tube. Being a nocturnal mammal the eye is comparatively

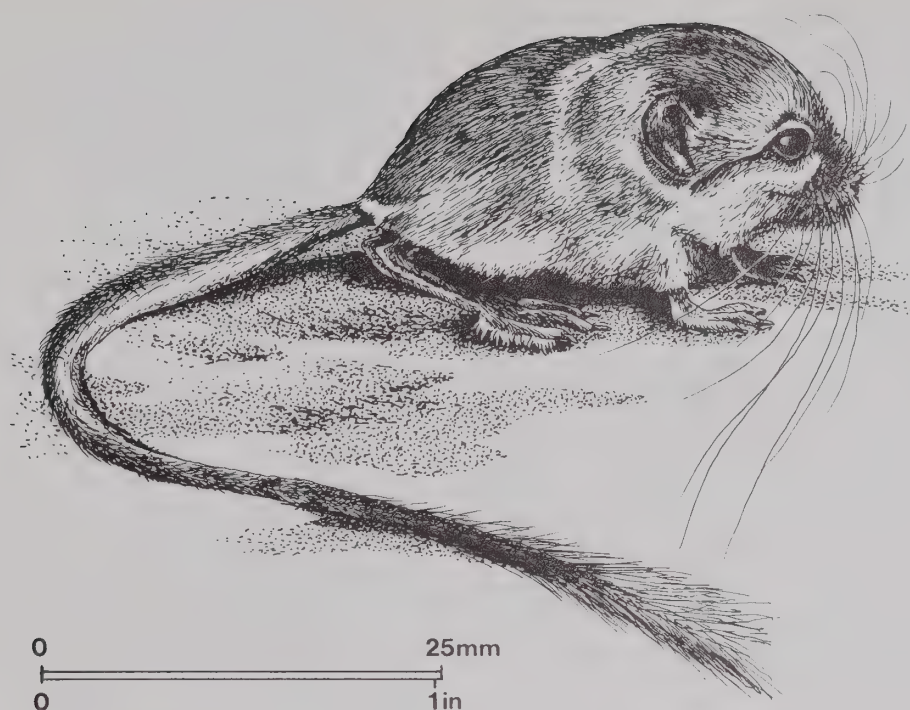


Illustration 70 *Salpingotus michaelis*: Fitz Gibbon's Pygmy Jerboa. (Based on captive specimens in possession of J. A. W. Anderson, collected from Nushki, south west Baluchistan.)

large with the iris black. The three toes on the hind foot are equal in length and the most striking feature about its foot is the stiff fringe of white bristles along the outer margin of both the outer toes. The central toe also bears shorter bristles. It moves about on these toes, the rest of the tarsus being carried well clear of the ground. The body fur is soft and silky, and of a pale yellow-ochre or sandy-buff colour. The hind legs are pinkish in colour. The fur on the inside of the limbs, belly and lower cheeks is pure white. Even when stretching to reach some plant food this little Jerboa appears to have practically no neck, with a large round head being fused onto a short round body of almost the same dimensions. The tail is quite long and well covered with hair throughout. It carries a few sparse longer hairs at its tip which are black with white bases. Another striking feature of this Dwarf Jerboa is in the use of its tail for fat storage. In some specimens the base of the tail is quite grossly thickened with subcutaneous fat in its proximal portion. In one such specimen the tail was 4mm ( $\frac{5}{16}$  in.) at its widest point which was at a distance of 15mm ( $\frac{5}{8}$  in.) from its base (see Chapter 4). Females appear to have only six mammae, though E. Walker (1964) gives eight for all species. *Salpingotus crassicaudata* does in fact have eight mammae (Sokolov, 1963).

**Distribution and Status:** This Dwarf Jerboa is found only in areas of rolling sand-dunes or barren flat gravel and sandy plains. These areas in south west Baluchistan happen to be between 1060 and 1520m (3500 and 5000ft) elevation, and are characteristically associated with *Haloxylon ammodendron* bushes.

In Pakistan this Pygmy Jerboa occurs around the Chagai Desert Plateau as well as around Nushki further to the north and right up to the Afghanistan border.

This Pygmy Jerboa was discovered by J. A. W. Anderson

in May 1965 at which time it was assumed to be Thomas's Pygmy Jerboa (*Salpingotus thomasi*). Fifteen of these original captive specimens were sent to J. Fitz Gibbon, who after examination, pronounced them to be a new species which he named *Salpingotus michaelis* (Fitz Gibbon, 1966). It is noteworthy that *S. thomasi* is represented by but one single speci-



*Salpingotus michaelis* Known distribution  
Probable range

Distribution Map 86 Fitz Gibbon's Pygmy Jerboa or Dwarf Three-toed Jerboa.



men which is in the British Museum. It is over 50 years old now and much faded, and moreover its skull is damaged and the label does not indicate what part of Afghanistan it was collected from. Furthermore, it has not subsequently been discovered in Afghanistan (Niethammer, 1965 and Hassinger, 1968). *S. michaelis* sp. novum has been separated from *S. thomasi* on the basis of smaller size, presence of only three pairs of mammae in females plus minute relative differences in skull anatomy. In my opinion, until more is discovered about *S. thomasi* and more skull material can be examined, there remains a possibility that these two populations may be only subspecies. Development of the skull in these jerboas is very slow so that sub-adult specimens have quite significant anatomical differences when the skull is compared and measured with the skulls of adult specimens.

There are three other described Russian species of Pygmy Three-toed Jerboa, one of which was only discovered in 1969 (Vorontsov and Smirnov, 1969). They are found in the Gobi Desert, Mongolia and Kazakstan in Russia, so the discovery of this little jerboa in south western Baluchistan has been of great interest.

According to J. A. W. Anderson it is quite numerous in the Chagai Plateau once its colonies can be located.

**Biology:** Remarkably little is known about this whole genus of Dwarf Jerboas because their total world distribution is restricted to some of the remotest areas of central Asia (Walker et al., 1964). Moreover very few specimens have ever been collected even of related species and they are delicate animals which do not survive long in captivity. Observations on the Baluchistan population indicated that they are strictly nocturnal in activity and live in extensive burrow systems which they dig themselves. They are loosely colonial and it is usual to find a number of burrows in the same locality. They also appear to live gregariously in their burrow system.

They appear to feed partly on grass seeds and also on grass stems and other vegetable matter. Their molar teeth are high crowned with relatively smooth grinding surfaces adapted to a herbivorous diet. There is no evidence that they eat any insects and certainly captive specimens showed no interest in any insects or small soil borne crustacea which were proffered to them.

When moving abroad at night they proceed by rapid very small hops from the hind feet with the fore-limbs completely concealed in their body fur and not touching the ground. The long tail is used as a balancing organ and when pursued they raise this tail clear of the ground and make longer leaps. Observations on captive specimens indicated that even the adults prefer to spend the day gregariously huddling together in bodily contact with each other. Up to five or six individuals will sleep in this manner. They either sleep upright with the head bent down towards the belly or lying on their back with their hind feet curled up towards their head. They spend quite a large portion of their active hours in digging in the soft sand and at this time they do use their fore-feet for excavation. They also shovel loose sand with their noses during excavating, a trait shared with *Jaculus* species. When burrowing they kick the loosened soil backwards with their hind feet. They also use their fore-feet to hold food. Their movements are so rapid that one is reminded of tiny clockwork toys.

Their period of gestation and other details of breeding are unknown. However several freshly captured females in the possession of J. A. W. Anderson have produced litters. The young are born naked and do not show visible hair until about 10 days of age. Two to four seems to be the usual litter

size (Anderson, pers. comm.). Fitz Gibbon gives the dimensions of a newly-born specimen as 17mm ( $\frac{11}{16}$  in.) head and body with tail 11mm ( $\frac{7}{16}$  in.) (Fitz Gibbon, 1966). In the opinion of J. A. W. Anderson (pers. comm., 1967) the females have poorly developed maternal instincts, often burying their newly-born young in the sand and neglecting them in other ways. Specimens from Nushki in Baluchistan seemed to have two breeding periods, with the first litter being produced towards the end of June and a second litter being produced almost immediately after the first was weaned in August.

This Pygmy Jerboa does not appear to hibernate in winter and captive specimens remained active right up to the end of December. However they became torpid each day and could be picked up and handled during the cold winter months though they were normally active and agile by night-fall, at which time it was not possible to pick them up.

Such a small and seemingly defenceless creature is probably preyed upon by many reptiles which abound in that area, as well as owls and mammals. From examination of tracks there is evidence that Monitor Lizards (*Varanus* spp.) and snakes such as Sand Boas (*Eryx tataricus*) and Vipers (*Eristicophis* spp.) which are common in that area, enter their burrows and probably prey on this Pygmy Jerboa. It is almost certain that the Little Owl (*Athene noctua*) which occurs in the area also preys on this Jerboa, as does the Sand Cat (*Felis margarita*).

## SUBFAMILY DIPODINAE

This subfamily covers the jerboas which are divided into 10 genera and about 25 species. They are found in the great desert regions of North Africa, south western Asia, Mongolia and northern China.

All the *Dipodinae* have greatly elongated hind legs and have developed a saltatorial gait.

### Key to the Subfamily DIPODINAE

Specialized Jerboas of medium size adapted to a saltatorial mode of progression with greatly elongated hind legs. Three central metatarsals fused to form a cannon bone and having only three functional toes on hind foot but sometimes with two reduced non-functional outer toes. Tail long and terminating in a conspicuous tuft or flag of black and white hairs. Cheek teeth with moderate or low cusps and with third molar well developed.

### Genus ALLACTAGA Cuvier, 1836

There are nine species of jerboas within the Genus *Allactaga*, which are characterized by having greatly elongated ears, and five toes on the hind feet. The first and fifth digits are much shorter than the three central toes (see Fig. 66). The tail always terminates in a prominent tuft of longer hairs. The auditory bullae are not greatly inflated as in the Genus *Jaculus* (see Fig. 65).

### Key to the Genus ALLACTAGA

Dental formula: incisors 1/1; canines 0/0; pre-molars 1/0; molars 3/3.

Hind foot with five digits. Ear tube-like but greatly elongated. Upper incisors smooth and with whitish enamel and prunedont.

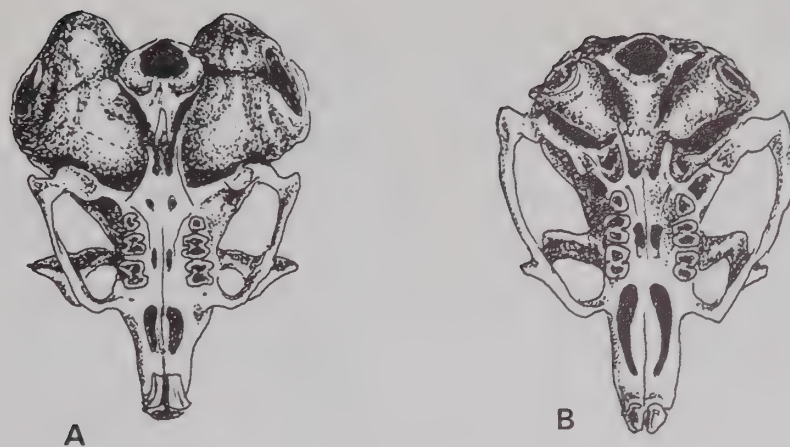


Fig. 65 Showing ventral view of skulls of:

A. *Jaculus blanfordi*.

B. *Allactaga elater*.

Note shortened palatal foramen and greatly inflated tympanic bullae of *Jaculus* species. Note elongated palatal foramen and pro-odont upper incisors of *Allactaga* species with much smaller tympanic bullae.

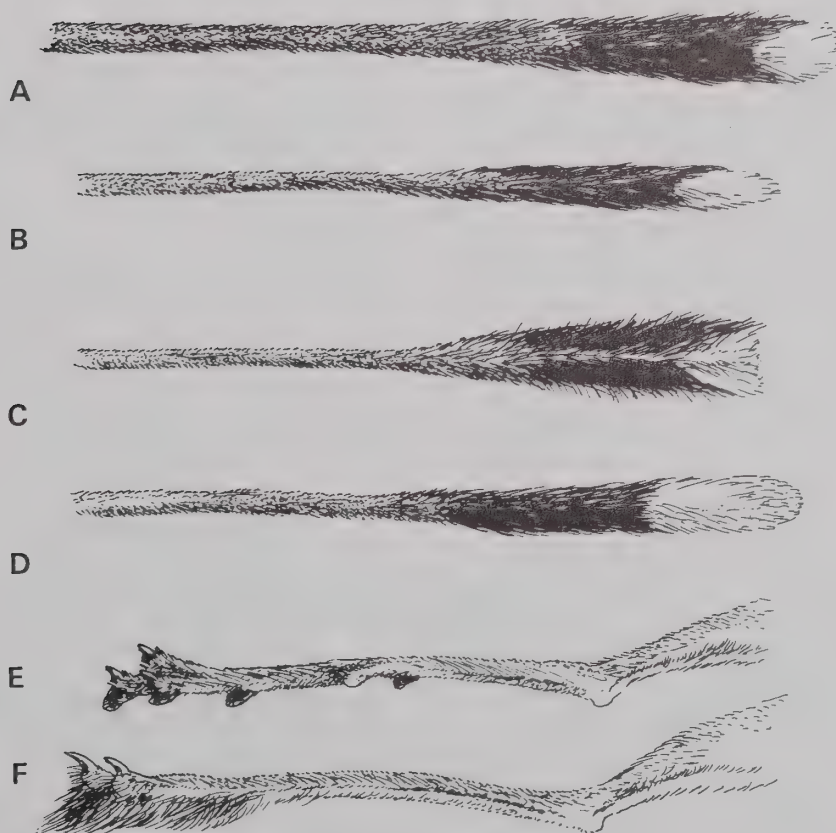


Fig. 66 Showing different appearances of Jerboa species.

Tail tips.

A. *Allactaga williamsi*.

B. *Allactaga hotsoni*.

C. *Allactaga elater*.

D. *Jaculus blanfordi*.

Hind legs.

E. Right hind leg of *Allactaga elater*. Note first digit or pollex half way up tarsus with digital and plantar pads exposed.

F. Right hind leg of *Jaculus blanfordi*. Note absence of first digit and long hairs under toes concealing digital pads.



**Key to the Pakistan Species of ALLACTAGA**

(See Fig. 66).

- (i) Smallest size: ear 32–36mm, hind foot 50–55mm.  
Tip of tail brush flattened dorso-ventrally and feather-shaped.  
... *Allactaga elater*
- (ii) Medium size: ear 44–46mm, hind foot 57–59mm.  
Tip of tail brush rounded and not very pronounced.  
... *Allactaga hotsoni*
- (iii) Largest size: ear 50mm, hind foot 62–68mm. Tip of tail rounded with conspicuous black terminal tuft preceded by restricted area of white hairs.  
... *Allactaga williamsi*

**ALLACTAGA ELATER**

*Allactaga elater* Lichtenstein, 1825; Small Five-toed Jerboa (see Illustration 71).

**Description:** Despite its name this is quite a large Jerboa with greatly elongated hind legs developed for jumping, small almost vestigial fore-limbs, and long rabbit-like ears. The body fur is long, soft and silky, clinging to the body contours and it is a yellowish grey or sand colour with some mixture of black-tipped hairs. The lower cheeks, belly and inside of the limbs are pure white. The tail is long, slender and well covered with short hairs throughout its length, the tip terminating in a conspicuous black and white flag of longer hairs (see Fig. 66). The extreme distal portion is white preceded by black hairs. These radiate outwards in a feather shape, being flattened dorso-ventrally. The tail averages about 133 per cent of the head and body length, and is obviously an important balancing organ. This Jerboa normally rests with only the toes of the hind-feet and the distal one-third of the tail being in contact with the ground. The terminal tail tuft probably helps this animal to execute sharp turns as well as assisting in balancing and supporting it when at rest. The head

is rounded with a very foreshortened muzzle and large protuberant eyes with black irides. The front of the muzzle bears stiff radiating hairs, almost like bristles, and is used by this jerboa to shovel loose sand when burrowing. The upper incisors are markedly prouodont, and are adapted as digging tools (see Fig. 67). In contrast to the upper incisors of the Genus *Jaculus*, the outer surface is smooth without any longitudinal groove. They are coated with white enamel. Unlike *Jaculus* which has only three upper cheek teeth, in *Allactaga* a minute pre-molar is also present in front of three molars. Moreover the skull of the *Allactaga* species can be distinguished from *Jaculus* species by comparatively longer palatal foramen and uninflated auditory bullae (see Fig. 65). The vibrissae, which are mostly black in colour, are very long, some of them almost equalling the head and body length and measuring up to 85mm, (3 $\frac{3}{4}$ in.). The ears which are normally carried erect are bluntly rounded at their tips with the outer margins forming a complete tube at their base. They are covered with fine buff hairs on their dorsal surface. The hind legs appear long and delicately built from the tarsus downwards. The second and fourth toes are slightly shorter than the central toe and all three normally come into contact with the ground. The first and fifth outer toes are situated half way up the tarsus and are very small and apparently in the process of becoming non-functional. The claws are short but stout (see Fig. 66). There are short stiff hairs surrounding the small digital pads but the soles of the hind feet are quite naked.

*A. elater* as its name implies is smaller than the other *Allactaga* species. The average head and body length of 14 specimens from Baluchistan is 106mm (range 100–125mm). The tail average is 164mm (range 145–175mm). The hind foot average is 53mm (range 50–56mm). The ear average is 35mm (range 30–36mm).

*A. elater* can readily be separated from *A. hotsoni* by its smaller size with the hind foot never exceeding 56mm (2 $\frac{1}{4}$ in.) The tail tuft is flattened in a feather shape whereas that of *A. hotsoni* is more rounded or pencil shaped. Generally the tail of *A. elater* never exceeds 185mm (7 $\frac{1}{4}$ in.).

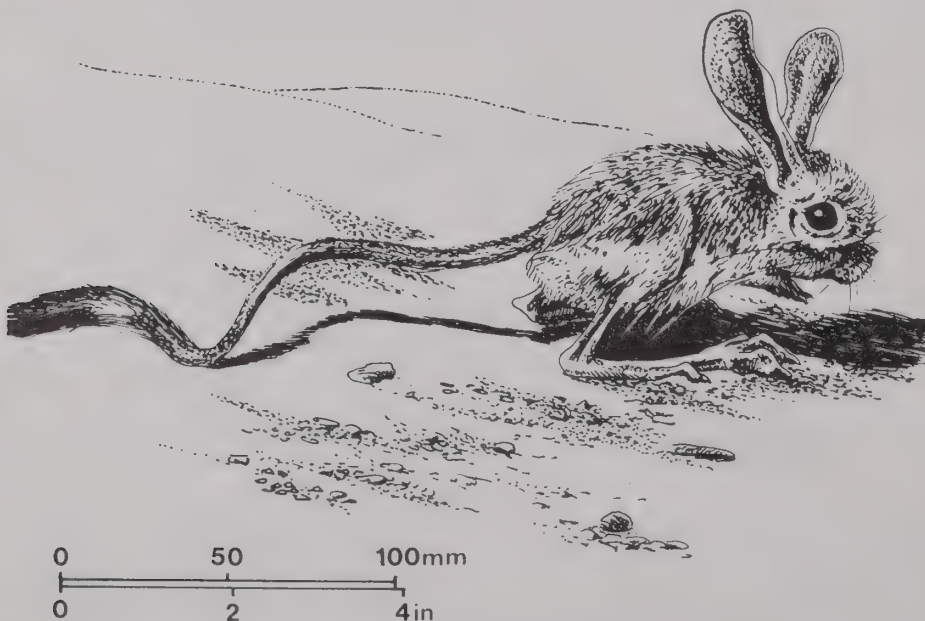


Illustration 71 *Allactaga elater*: Small Five-toed Jerboa.  
(Based on captive specimens collected from Chaman,  
Baluchistan.)

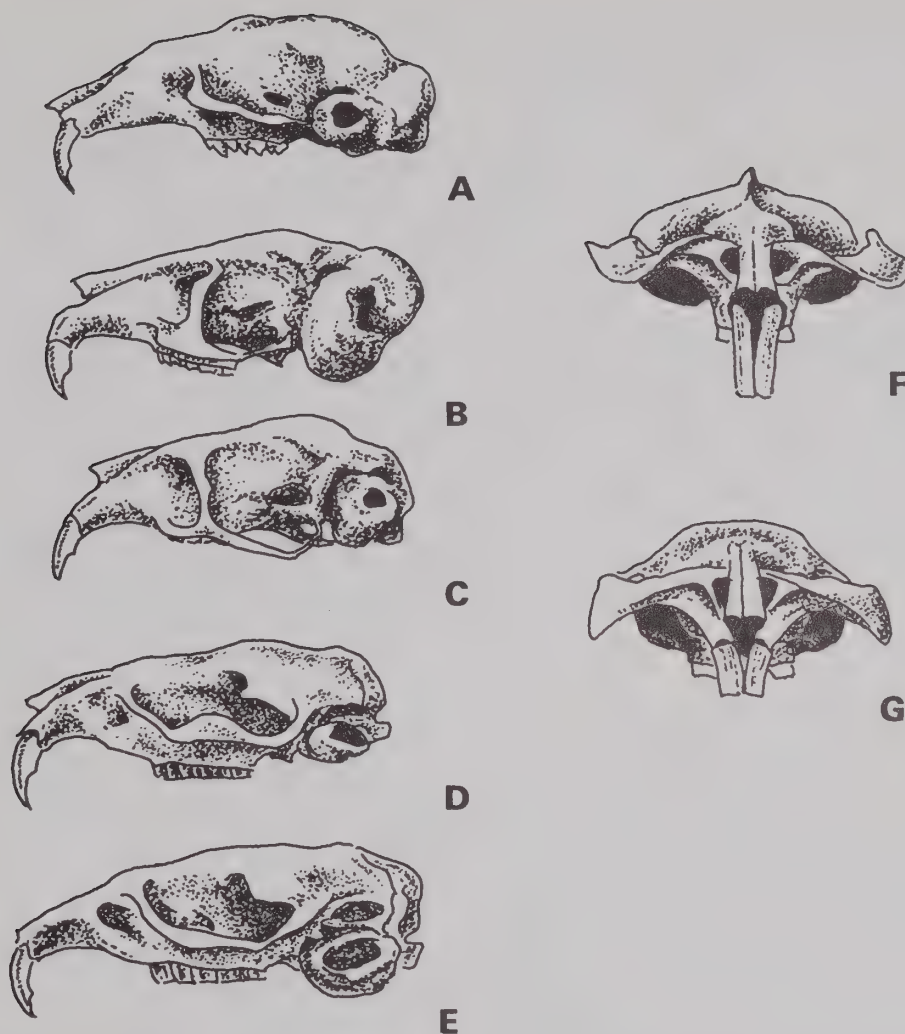


Fig. 67 Lateral view of rodent skulls representing *Dipodidae* and *Microtinae*.

- A. *Sicista concolor*. Note cuspidate cheek teeth and small tympanic bulla.  
 B. *Jaculus blanfordi*. Note flat crowned cheek teeth with highly inflated tympanic bulla.  
 C. *Allactaga elater*. Note pro-odont incisor with smaller tympanic bulla.

- D. *Hyperacrius wynnei*. Note small tympanic bulla, developed sagittal crest.  
 E. *Alticola roylei*. Note less developed sagittal crest.  
 F. Front view skull of *Ellobius fuscocapillus*.  
 G. Front view skull *Hyperacrius wynnei*. Note prominent development of sagittal crest in *Ellobius*.

**Distribution and Status:** This five-toed Jerboa is an inhabitant of upland or cold desert regions but is fairly adaptable to living in alluvial soil, gravel flats or even rocky mountain slopes. Generally speaking it will not be found in extensive sand-dune areas. It is occasionally found on the border of cultivated fields and is much more widespread in Baluchistan than its congener *A. hotsoni*.

It is however of rather restricted distribution in Pakistan being mainly found in the extreme south western regions from Chagai up to Chaman in the north, in regions bordering the desert basin of Seistan. It also occurs further north around Loralai and has been collected from the outskirts of Quetta and southwards to Mach. It occurs throughout the Chagai Plateau including Nushki, Dalbandin and as far west as Noa Khandi. In fact it is quite plentiful in this region. In the northern part of its range it has been collected at Chaman, Pishin and Sorab and it probably extends eastwards along the valley from Loralai.

Extra-limally, it has been collected in Afghanistan around

Ghazni and Kandahar. It was described as being particularly abundant along the road between Girisch and Diliram (Niethammer, 1965). In Iran it is widespread throughout the plains from Tehran through Khorassan and Kerman and down to Fars (Lay, 1967). In Russia it occurs from Kazakstan through to Turkestan in the east and is particularly plentiful in the basin of the Amu Darya River (Flint et al., 1965).

**Biology:** Five-toed Jerboas are exclusively nocturnal in activity. They live in loose or scattered colonies, spending the day sheltering in underground burrows which they excavate themselves. These burrows are extremely difficult to find because they are generally quite short in depth and with the burrow entrance sealed up by a plug of loose sand when they are inside. Moreover there seems to be little evidence of excavated earth in the vicinity of their burrows. It is much easier to find colonies of this Jerboa at night-time when they are active and feeding on the surface. Generally each burrow is occupied by a single individual, and the members of a





Distribution Map 87 Small Five-toed Jerboa.

colony live separately. They can excavate their burrows in surprisingly hard ground, using their incisors to assist them in digging. S. I. Ognev (1948) recounts having to use a crow-bar to dig open one such burrow. In such hard ground the burrow may only be 150cm (59in.) in length and a typical burrow has one lateral branch or escape tunnel which is excavated to within an inch or two of the surface. If some predator enters the burrow the Jerboa can burst through the escape tunnel to the surface. This lateral branch is completely invisible from above the ground and in some clay soils may go to within 10mm ( $\frac{3}{8}$ in.) from the surface. The main burrow terminates in an enlarged circular chamber which does not seem to be lined with any soft material. It has been observed with a captive animal that after loosening the soil with its teeth during excavation it will kick loose soil backwards with powerful strokes of its hind feet.

The Baluchistan population of this Jerboa seems to be exclusively herbivorous and there is no evidence that they will eat insect food. They eat grass seeds as well as green leaves, generally from halophytic succulent plants which are able to survive in that area. In Iran they have been recorded as feeding on the Chenopod (*Halostachys caspica*) (Lay, 1967). In Russia they have been recorded as eating the leaves of *Salsolium nedulosae*. In the Chagi Plateau where it occurs *Haloxylon salicornicum* and *Psueda fruticosa* occur often as dominant plant species and must form an important plant food. Where cultivated fields are available, this Jerboa no doubt feeds on lucerne and melons.

The most striking feature about these rodents is the speed at which they can travel. When frightened or pursued they are certainly capable of jumping 2.4m (8ft) in one hop. They can probably escape most predators if given enough warning of approach. When moving leisurely they will support the fore-part of the body on the front legs. They also use their fore-limbs to assist in grooming their fur. Normally, however, their gait is purely saltatorial. When travelling on a smooth hard surface they can reach almost 48 km/hr (30mile/hr), as

has been testified by travellers at night who have followed this animal in the headlights of their cars.

The breeding season seems to last from the spring to the early autumn and it is probable that more than half the mature females produce two litters a year. In Baluchistan litters have been dug out of burrows in late April as well as in the end of June indicating that there is no marked periodicity in the breeding cycle. Captive specimens have produced litters of four young (Walker et al., 1964). The Russian zoologist Kolesnikov records a litter of six (Ognev, 1948). It is believed that the young mature rather slowly as a burrow excavated in June contained only two young which were practically adult size but were still with eyes closed and unable to move about freely. Nothing has been recorded about the gestation period but it may be around 40 days like *Jaculus* species. Young Jerboas are greyer in pelage than adults. A few Jerboas obviously breed in the middle of the summer and this has also been observed by Russian zoologists (Kolesnikov, 1939, cited in Ognev, 1948). It is not known whether such June born litters result from failure to breed earlier in the spring. They may also be the result of mortality of the first litter.

This Jerboa's speed and agility must make it very difficult for any predator to catch it in the open, but presumably they are occasionally taken by the Eagle Owl (*Bubo bubo*), Marbled Pole Cats (*Vormela peregusna*), the Sand Cat (*Felis margarita*) and Blanford's Fox (*Vulpes cana*), all of which frequent the same habitat in Baluchistan. Various species of snakes such as Sand Boas (*Eryx* spp.) and Sand Vipers (*Eristicophis mcMahonii*) no doubt succeed in entering the burrows to prey upon these Jerboas.

Observations on captive specimens indicate that they are not so social as *Jaculus*, preferring to sleep separately. They are quite tolerant of their own species when kept together but will fight furiously with specimens of *Jaculus blanfordi* when these are placed in the same enclosure.

There is conflicting evidence about the winter activity of these Jerboas. In the Trans-Caucasian region of Russia, they were definitely found to hibernate from mid November to mid March (Ognev, 1948). Hutton is quoted in Sterndale (1884) that *Allactaga* in Afghanistan hibernates from late October till April. D. M. Lay (1967) found this Jerboa still active and foraging at night in Iran at the end of October and they seem able to withstand extreme cold. If they do not undergo true hibernation in the southern latitudes of Baluchistan they are probably capable of remaining underground in a state of torpor for limited periods during winter without emerging above ground to feed.

### ALLACTAGA HOTSONI

*Allactaga hotsoni* Thomas, 1920; Hotson's Five-toed Jerboa.

**Description:** This Jerboa is not well represented in museum collections and is of very restricted world distribution. It is very similar in appearance to *Allactaga elater* and may be considered a sibling species. It has the same elongated rabbit-like ears and long tail terminating in a conspicuous black and white flag. It has the same rather soft and silky body fur of a sandy-yellow or greyish-buff colour. *A. hotsoni* can be separated from *A. elater* by an examination of its tail flag or tuft. In *A. hotsoni* the terminal tuft is rounded and like that of *A. williamsi* whilst in *A. elater* the flag is flattened or feather-shaped (see Fig. 66). If a sufficient number of speci-

mens can be compared it will be found to have slightly larger average body size than the Baluchistan population of *A. elater*, and to have distinctly longer ears. The average ear length of six specimens of *A. hotsoni* from Baluchistan is 43mm (range 39–46mm) ( $1\frac{3}{4}$ in.), whereas the average ear length of 18 specimens of *A. elater* from the same region was 35mm ( $1\frac{3}{8}$ in.). Their head and body length averaged 126mm ( $4\frac{7}{8}$ in.) (range 111–161mm) with the tail averaging 174mm ( $6\frac{7}{8}$ in.) (range 134–192mm). It is noteworthy that the hair on the under-surface of the tarsi of the hind foot is blackish-grey in *A. hotsoni* whereas the hair in the same region of the hind foot in *A. elater* is a paler greyish-buff. Specimens of *A. hotsoni* collected from gravel plains and stony regions around Noa Khundi have quite a blue-grey pelage which is probably a valuable protective adaptation. Specimens from further north around Chagai in sandy regions were buff coloured and indistinguishable from *A. elater* in pelage.

**Distribution and Status:** This species appears to inhabit even more barren desert areas than *A. elater*. It seems to avoid steeper rocky slopes and is certainly not found in mountain areas. However it often frequents stony peneplain where practically no other rodent exists.



Distribution Map 88 Hotson's Five-toed Jerboa.

The type specimen was described from Kont, 20 miles south west of Sib. M. S. Siddiqi (1961) includes this species in his *Checklist of the Mammals of Pakistan* on the basis of this single record. D. M. Lay (1967) points out that Kont is in Kerman Province in south western Iran and not in Pakistan territory. However *A. hotsoni* has subsequently been collected in Pakistan by the University of Maryland Expedition from eastern Kharan, around Noa Khundi, and northern Mekran from around Panjgur and Prom, 88km (55miles) to the south west. It has also been collected by me from Anam Bostan.

Living in such a barren desolate region this Jerboa is of no economic significance.

**Biology:** Presumably much the same as for *A. elater*. Virtually nothing has been recorded about the habits of this jerboa. It is nocturnal and lives in dispersed colonies in underground burrows. It is presumed to be mainly herbivorous.

#### ALLACTAGA WILLIAMSII

*Allactaga williamsi* Thomas, 1897; Williams' Jerboa  
Synonym *Allactaga euphratica*

This species has not been recorded in Pakistan territory. It is described hereunder because it is closely similar in appearance to *A. hotsoni* with which it has been confused (Lay, 1967). It has been collected in north eastern Afghanistan around Kabul and the Shibar Pass (Hassinger, 1968). It does not occur in south eastern Iran but the possibility of its occurrence within the desert areas of Pishin District in Baluchistan is not to be ruled out when more extensive collecting can be carried out. This Jerboa is distinguished mainly by its larger size and very prominent rounded tail flag. A typical specimen from Afghanistan measured 140mm ( $5\frac{1}{2}$ in.) head and body length, with the tail 207mm ( $8\frac{1}{8}$ in.), the hind foot 66mm ( $2\frac{5}{8}$ in.) and the ear 50mm ( $1\frac{5}{8}$ in.).

#### Genus JACULUS Erxleben, 1777

There are four species presently known to occur in this genus. They range from North Africa through Arabia and into southern central Asia from Iran up to Russian Turkmenia. In contrast to the Genus *Allactaga* they have comparatively shorter rounder ears, and the auditory bullae are greatly inflated extending beyond the occipital region (see Fig. 65).

#### Key to the Genus JACULUS

Dental formula: incisors 1/1; canines 0/0; pre-molars 0/0; molars 3/3.

Hind foot with only three digits and 68–72mm in length. Hind legs greatly elongated for saltatorial mode of progression. Well developed brush of stiff hairs on toes of hind foot. Ears tube-like but markedly shorter and broader than *Allactaga*.

#### Key to the Pakistan Species of JACULUS

Tail terminating in conspicuous black and white tuft. Skull with a very broad brain case with enlarged tympanic bullae. Upper incisors grooved and not prurodont.

... *Jaculus blanfordi*

#### JACULUS BLANFORDI

*Jaculus blanfordi* Murray, 1884; Blandford's Jerboa or Greater Three-toed Jerboa or Persian Brush-footed Jerboa (see Illustration 72).

**Description:** Though *J. blanfordi* is by no means the biggest species in this genus (*J. orientalis* has a head and body length up to 150mm ( $5\frac{7}{8}$ in.) with the tail 250mm ( $9\frac{3}{4}$ in.)), it is considerably larger than *Allactaga elater*. Superficially it looks closely similar, having elongated hind legs, vestigial fore-limbs, and a very long tail terminating in a conspicuous black and white flag. The toes on the hind foot are more or less equal in length and bear rather short stout claws. They are thickly covered with stiff cream-coloured hairs on their underside (see Fig. 66). It has a large rounded



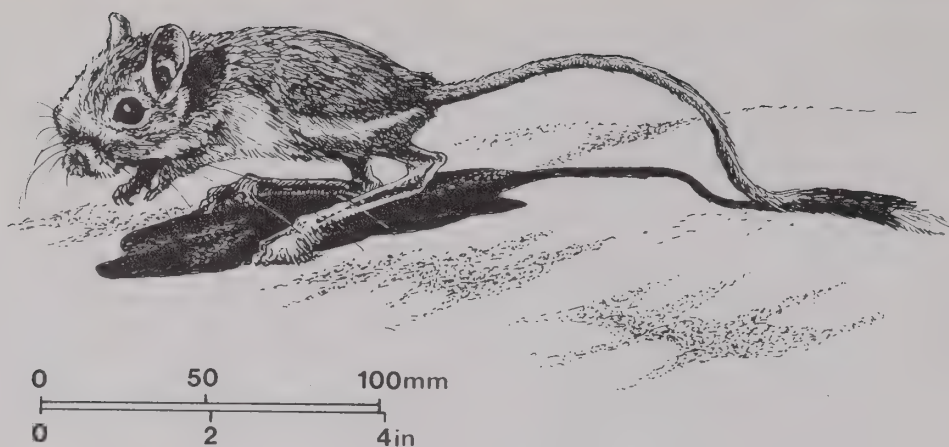


Illustration 72 *Jaculus blanfordi*: Blanford's Jerboa.  
(Based on captive specimen collected in November  
from Nushki, south west Baluchistan.)

head with prominent protuberant black eyes and a bluntly rounded muzzle. The ears of this jerboa have the outer margins forming a complete ring at the base and they are slightly elongated and oval in outline. When encountered at night it can readily be distinguished from the Five-toed Jerboa by its relatively shorter broader ears. The upper incisors bear a prominent longitudinal groove and are coated with white enamel. They are not markedly prouodont. The muzzle is surrounded by radiating stiff hairs and observation on captive specimens show that it regularly uses the forepart of its face to shovel and push sand during excavation. The vibrissae are almost equal to the head and body length and measured 115mm (4½ in.) in one adult specimen. They are white in colour in contrast to the black vibrissae of *Allactaga elater*.

The body fur is soft and rather long and of a pale sandy-buff colouration. There is an indistinct crescentic shaped white area around the base of the pelvis extending across either flank. The lower cheeks, belly and inside of limbs are covered with pure white fur. The proximal part of the tail is well clothed with short buff hairs and the distal one-third has a black and white tail flag which is rounded and not feather shaped as in *A. elater*. Moreover the extreme distal white portion is usually more extensive than in *A. elater* (see Fig. 66).

The skull shows greatly inflated tympanic bullae and relatively shorter palatal foramen in contrast to the skull of *Allactaga* species. A series of three skulls in the Smithsonian Museum collection varied from 32–39mm (1¼–1⅞ in.) occipito-nasal length. Dimensions of six specimens from Baluchistan are as follows. Average head and body length 128mm (range 116–135mm) with average tail length 191mm (range 185–198mm) (7⅝–7⅞ in.), hind feet average 67mm (range 64–72mm) (2½–2⅞ in.) and the ears average 25mm (range 22–26mm) (⅞–1 in.).

**Distribution and Status:** In Baluchistan this jerboa is only encountered in the southerly warmer latitudes associated with the most barren arid regions where there are extensive sand-dunes interspersed with gravel plains. It avoids rocky and mountainous areas and will not burrow in such hard soil as *Allactaga elater*. In south west Baluchistan it occurs up to about 1220m (4000ft).

Until about 1965 the total known range of this jerboa was confined to eastern desert regions of Iran and there were very

few specimens in any museum collection (Lay, 1967). The University of Maryland Expedition discovered this jerboa in western Baluchistan in 1965 (Mirza, 1965). They also collected specimens from 10km (6¼ miles) east of Dalbandin. J. A. W. Anderson subsequently trapped this species for commercial export as far south as Kharan and all along the banks of the Lora River, which is a dry channel most of the year, running through the Chagai desert basin. I have found it common right up to the outskirts of Nushki Town. It does not appear to have extended much further south in the Mekran nor to have extended as far north as *A. elater* and there are no records of its occurrence north of Nushki.

In Iran it extends from Teheran eastward to Khorassan and down to Fars Province, being confined to the eastern desert plains (Lay, 1967). It has only recently been collected from Seistan in southern Afghanistan around Kandahar, Girishk



*Jaculus blanfordi* [shaded box] Known distribution  
[unshaded box] Probable range

Distribution Map 89 Blanford's Jerboa or Greater Three-toed Jerboa.

and Qala-i-Kang (Hassinger, 1968). Frequenting remote uncultivated tracts this Jerboa is of no economic importance but is numerically quite abundant in suitable habitat.

**Biology:** They are non-colonial, burrowing rodents highly adapted to sand-dune conditions. Their burrows are remarkably small considering the size of the animal and the entrance is always plugged with loose sand. Generally it is a short tunnel with one additional escape branch to the surface and ending in a widened underground nest-chamber well lined with grasses and chopped vegetable matter. Observations on captive specimens indicate two characteristic resting postures. In colder winter months they invariably sit on the whole of their tarsi with the back curved forward and head completely tucked in under the chest. But in warmer weather they frequently rest lying on their side with hind legs extended very much in the manner of a kangaroo. Such a posture would not be possible if their underground rest chambers were not quite large. Despite the wide separation of their burrows they seem to be a social rodent, exhibiting a very mild disposition, and two to three individuals will often share the same burrow, huddling together during the daytime in sharp contrast to *A. elater* which sleeps singly. Fresh caught specimens make no attempt to bite when handled. As many as six adult specimens have been excavated from a single underground nest chamber.

Observations on captive specimens reveal that they are expert burrowers even in soft sand. They use their tiny forelimbs to help in excavating a burrow probably more than *A. elater*. They also use their nose in a bulldozer action. When burrowing upwards the pelvis is pressed to the ground and tarsi are straddled giving maximum purchase for exerting upward pressure and such an attitude is so readily and frequently adopted as to indicate that they are accustomed to making fresh exit tunnels whenever they wish to emerge to forage. They often enter their burrows using their forefeet for purchase and with the hind legs fully extended behind them, presumably an adaptation to passage through a small burrow entrance.

Strictly nocturnal, they do not emerge in warmer weather until one hour after darkness, according to my observations around Nushki. They are remarkably agile and can change direction suddenly by using their tail as a balancing organ. A Lesser Egyptian Jerboa (*Jaculus jaculus*) was recorded as leaping vertically 1m (3¼ft) when startled. Measurement of foot tracks of *J. blanfordi* when pursued showed that they could easily execute individual leaps of 2.25m (7½ft). Judging from the sparse vegetation surrounding colonies of this Jerboa as well as foot tracks, they cover considerable distances in their nightly foraging. They feed principally upon seeds and succulent halophytic vegetation. Around Aman Bostan they feed on the fruits of *Artemisia scoparia*. They also probably feed on grass seeds and stems of underground bulbs. A captive specimen readily ate wheat grains, millet seeds and even paper. Captive specimens show no interest in drinking water and in their natural habitat free water is rarely available and they must be well able to obtain their requirements from vegetation and the oxidation of carbohydrates. They use their fore-feet for conveying food to the mouth.

Breeding may extend from late winter to early autumn since this species does not appear to hibernate and in Iran a female was collected in 27 January containing three embryos (Lay, 1967). I secured a female on 25 March which produced a litter of three on 3 April. Newly born young are naked pink and blind and have relatively shorter tails

than adults whilst the hind legs are elongated but less conspicuous than in the case of adults. J. A. W. Anderson only encountered young in excavated nest burrows during the spring and summer months and found that litter sizes were generally three to four. The gestation period for *J. orientalis* is reported as 40 days (Walker et al., 1964), whereas that of *J. jaculus* is given as only 25 days (Lewis, Lewis and Harrison, 1965). The young are very slow developing and appear to remain in the underground burrow nest chamber for at least two months. Young Jerboas were excavated being almost adult size and well furred but with their eyes still closed and seeming relatively weak and inactive (J. A. W. Anderson, in lit.). Their body fur is greyer in colour than that of the adults at this stage.

Specimens have been captured in Kerman Province in Iran actively foraging above ground in late December when the ambient temperature was well below freezing (Lay, 1967). Observations on captive specimens indicate that in the colder winter months they appear to go through a daily cycle of complete torpidity equivalent to facultative hypothermia (see Chapter 3). Respiration rate and body temperatures are markedly lower, yet by the onset of darkness they become active again and the respiration rate is noticeably more rapid. These observations on captive specimens in Khanewal accord with those of Dr. Lay in late December in Iran, when he found that even prolonged handling of up to one hour during the daytime could not rouse them. I have observed that captive specimens being held in the mild climate of Karachi throughout January did not become torpid during the daytime, but that there was heavy mortality of this species in contrast to *A. elater* kept under similar conditions. Clearly a more careful study of these species' physiological responses to temperature changes would yield valuable information.

Probably the agility of the jerboa enables them to escape many predators but they may be more vulnerable to predation by reptiles than to mammalian carnivores. In Nushki area *Vulpes cana* is not uncommon and is often diurnal in its hunting. There was evidence of some burrows being excavated in Nushki area though this could have been through human agency. Leaf-nosed Vipers (*Eristicophis mcmahoni*) and the Sand Boa (*Eryx tataricus*) are astonishingly abundant in these sand-dune areas where *J. blanfordi* occurs. In Iran the remains of this jerboa were found in the stomach of a Desert Fox (*Vulpes rüppelli*) (Lay, 1967).

A captive specimen of *J. jaculus* lived for six years and four months in the Clifton Zoological Gardens (Crandall, 1964). Nothing is known about the longevity of *J. blanfordi*.

## FAMILY MUSCARDINIDAE — DORMICE

American authorities prefer to call this Family *Gliridae* (Simpson, 1945 and Walker et al., 1964). The family comprises seven genera and about ten species, all found in the palearctic region of the Old World. They are commonly known as Dormice or Hazel Mice and have been well known since ancient times, since several species are associated with man's activities.

They show interesting traits of ecological convergence towards the Flying Squirrels. They are strictly nocturnal in feeding activity, tend to be more vocal than the Murine rodents, and are very agile in leaping between branches, being arboreal in activity.

They can be distinguished from the Family *Muridae* by



the molar tooth row being brachyodont. These teeth are rooted and relatively low crowned. All species within the family, may hibernate in winter as well as accumulating winter food stores.

#### Key to the Family MUSCARDINIDAE

Dental formula: incisors 1/1; canines 0/0; pre-molars 1/1; molars 3/3.

Body form squirrel-like and adapted to an arboreal existence. Small rodents with tail covered with long hairs and bushy. Skull with inflated tympanic bullae and four upper and lower cheek teeth which are brachyodont with a series of transverse ridges across their crowns. Five toes on hind foot. Fibula fully fused with tibia.

#### SUBFAMILY MUSCARDININAE

#### Genus DRYOMYS Thomas, 1906

This is a monotypic genus, the single species being very widely distributed and adaptable and being the only representative of the family which enters the Indo-Pakistan sub-continent.

#### Key to the Pakistan Species of DRYOMYS

Head and body length 80–95mm with broad greyish black streak extending from muzzle through eye to base of ear. Bushy tail is uniformly coloured.

... *Dryomys nitedula*

#### DRYOMYS NITEDULA

*Dryomys nitedula* Pallas, 1779; Forest Dormouse (see Illustration 73).

**Description:** In anthropomorphic terms this is a rather pretty rodent with dense pinkish-grey fur, a thick bushy squirrel-like tail and a striking pattern of dark blackish-grey on either side of the face passing from the base of the ears through the eye to the muzzle, which is reminiscent of the European Badger (*Meles meles*). The lower cheeks and throat are yellowish-white and the pelage on the top of the head and hind neck tends to have a rufescent tinge. The feet are strongly developed with naked soles, each digit bearing very sharp recurved claws. The tail is generally 80–90 per cent of the head and body length with the proximal half bearing shorter hairs than the distal portion. The tail is noticeably feather-shaped, being flattened dorso-ventrally like that of *Hylopetes*. It is often darker grey than the rest of the body in Pakistan specimens.

The rather small rounded ears are sparsely haired only on the dorsal surface. The vibrissae are prominent and long. The upper incisors tend to be rather short and not markedly curved. They are covered with pale orange enamel and un-grooved on their anterior surface. Young specimens have much shorter softer fur lacking any rufescent tinge and their tails are much thinner and less bushy. In winter pelage, the fur of adults tends to be woolly at the base so that it cleaves open as the animal twists and moves. Average dimensions of eight specimens from Pakistan are as follows. Head and

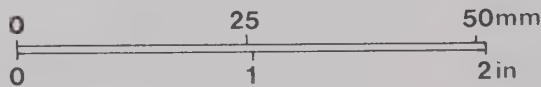


Illustration 73 *Dryomys nitedula*: Forest Dormouse. (Based on study specimens in British Museum, collected from Safed Koh Mountains, North West Frontier Province, and Smithsonian National Museum, USA, collected in Swat Kohistan.)

body length 94mm ( $3\frac{3}{4}$ in.) (range 80–110mm), tail 83mm ( $3\frac{1}{4}$ in.) (range 65–85mm), hind foot 21mm ( $\frac{13}{16}$ in.) (range 19–22mm) and ear 19mm ( $\frac{9}{16}$ in.) (range 16–21mm). Two Baluchistan adult specimens weighed 33 and 38g respectively.

**Distribution and Status:** In Pakistan the trivial name of this dormouse is somewhat misleading. It is not found in true forest but is associated with stunted junipers (*Juniperus macropoda*) or holly oak (*Quercus ilex*) in steppic mountain regions. In the Himalayas it is generally found in ravines or lower mountain slopes in regions where there is a scattered underbrush of wild honeysuckle (*Lonicera*) and barberry (*Berberis* spp.). In Baluchistan it is found at much higher elevations associated with *Juniperus*.

The first record of this Forest Dormouse in Pakistan territory was the specimen collected in 1906 by Captain Whitehead in the Upper Kurram Valley of the North West Frontier Province (Whitehead, 1907). There is also mention of a dormouse collected near Quetta being presented to the

occurs in extreme western Iran (Kurdistan) as well as central Iran in areas characterized by tumbled boulders and low scanty vegetation (Lay, 1967).

Elsewhere it extends throughout south Asiatic Russia including the Altai, Chinese Turkestan and European Russia around the Black Sea to eastern Europe around the Mediterranean.

It seems to be rare and localized in Pakistan and it cannot be considered of any major economic importance.

**Biology:** There are few direct observations recorded about the Pakistan population. However its habits have been well documented in other parts of its range, both in the USSR and Israel (Ognev, 1947, and Nevo and Amir, 1961 and 1964).

They are nocturnal in habits and rest by day in specially constructed shelters. They are not gregarious and occupy natural crevices under tree roots and tree hollows, as well as crevices between rocks. They have the habit of constructing nests from woven grass fibres for their daily resting as well as rearing of young. In better forested areas these nests are usually constructed in low bushes. In the Safed Koh Mountains of the North West Frontier Province one such nest was found under a tuft of grass at 3050m (10,000ft) elevation. It was a round ball of woven grasses. J. A. W. Anderson found a nest concealed under an overhanging rock and on the ground in Wam, Baluchistan. In Russia they frequently construct nests inside tree hollows and a typical nest in such a site has been described as being globe-shaped, measuring 20cm ( $7\frac{7}{8}$ in.) in diameter with a single entrance in the side (Ognev, 1947). During the summer months this dormouse has the habit of building several such globular nests. They will also appropriate birds' nests and line these with extra soft leaves and sheep's wool and use the site for rearing their young. An abandoned Magpie's (*Pica pica*) nest has been used by this dormouse in Europe and this same species typically occurs in many of the same regions of Pakistan where *D. nitedula* has been trapped.

They are omnivorous in feeding habits with a preference for young tree buds and flower buds in the spring and summer, subsisting mainly on various berries, nuts, wild fruits in the late summer and autumn. In Swat Kohistan there is evidence that they collect the acorn of *Quercus ilex* for their winter food stores and in Baluchistan there is evidence that they collect rose-hips from the numerous wild rose bushes (*Rosa webbiana*). In Iran a specimen was trapped with the stomach contents consisting of grasshoppers (*Acrididae*) (Lay, 1917). Specimens in Russia have been found with the stomach full of cockchafers (*Melolontha* spp.) (Ognev, op cit.) and in Israel their excrement was full of the chitinous remains of beetles (Nevo and Amir, 1961). In Europe they have been recorded as eating all kinds of insect larvae, birds' eggs and even newly born nestlings. They also damage ripening apples by gnawing these on the tree. There is no evidence at present that they do any damage in Baluchistan to the apricot and apple orchards, and in fact they often occur on bare rocky hillsides well away from cultivated orchards.

The gestation period is believed to be  $5-5\frac{1}{2}$  weeks and the young are born blind, naked and quite helpless. Their eyes open on the sixteenth day but they do not leave the nest until about three weeks of age (Nevo and Amir, 1961). Though the female has eight mammae, two to five young seem to be the most commonly recorded litter sizes in Europe and the USSR. Young have been discovered in the USSR in all months between May and August and in Israel



*Dryomys nitedula* Known distribution  
Probable range

Distribution Map 90 Forest Dormouse.

Baluchistan Natural History Society two years later though the species was apparently not identified (JBNHS, 1909). The University of Maryland Expedition collected specimens in 1964 and 1965 from northern Dir and Swat Kohistan. J. A. W. Anderson found this rodent in 1966 near Wam in north east Baluchistan in a very treeless rocky region. It has since been collected in the upper part of the Urak Valley just north of Quetta, as well as in Ziarat above 8500ft elevation. When collecting is possible it will probably be found in the forest regions around Fort Sandeman as well as south Waziristan, as these would seem to provide ideal biotope. It also occurs in the Gishk mountains near Harboi in Kalat and this must represent the southernmost distribution of its range in Pakistan.

Surprisingly, though it has been known in Kabul since the nineteenth century, it has still only been collected from the region of Paghman in that country (Hassinger, 1968). It



breeding occurs from March to December, each female producing two to three litters per year (Nevo and Amir, 1964). The nest discovered by Captain Whitehead contained three young in mid June. It is believed that the females do not become sexually active until the following summer after birth when they are nine months to one year old.

It is not known how long the Pakistan population hibernates in winter. In Russia they hibernate from November to March, and probably in the Himalayan regions they also undergo three to four months' hibernation whereas in southern parts of their range (Baluchistan) they may only undergo short periods of dormancy. Studies in Israel showed that the population there remained active and foraging at night throughout the winter (Nevo and Amir, 1961). They characteristically sleep curled up in a ball with the tail wrapped around the body and cannot be awoken during true hibernation without being artificially warmed. However they do emerge occasionally during this winter sleep to eat some of their hidden stores of fruit and nuts. A captive specimen has been recorded as lapping water readily (Walker et al., 1964).

The Forest Dormouse appears to be quite an aggressive rodent and in captivity they will bite if handled. Several observers have recorded that they are quite vocal whilst feeding at night, emitting spitting and snarling sounds (Walker et al., 1964). Russian observers have distinguished a variety of calls expressing alarm, fear and excitement. When alarmed they have a thin high pitched call which can be syllable-ized 'see-see-see'. When angry it has been described as laying back its ears and twitching the tip of its tail rather in the manner of a cat (Ognev, 1947). They will regularly feed upon the ground but are also extremely agile in clambering around low bushes and jumping from branch to branch in trees. Their bushy tail no doubt assists them in balancing and leaping.

Nothing is known about the predators on this dormouse but in Baluchistan it occurs in the same biotope with *Martes foina* and *Vormela peregusna*. Also in Swat Kohistan it occurs in the same region as *Martes foina* and both Scully's Wood Owl (*Strix aluco biddulphi*) and the Pallid Scops' Owl (*Otus brucei*). Being nocturnal in feeding activity it no doubt falls a prey to both these owl species. There are no actual records for the longevity of this species but the related Edible Dormouse (*Glis glis*) has lived for four years and one month in the Regents Park Zoo and the Hazel Dormouse (*Muscardinus avellanarvis*) has lived for two years eleven months in captivity (Crandall, 1964).

## FAMILY MURIDAE

*Muridae* comprises by far the largest family in the whole class of Mammalia. Ellerman and Morrison-Scott in their checklist (1951) include the *Cricetidae* as a subfamily but more recent systematists (Walker et al., 1964, and Anderson and Jones, 1967) in dealing with this complex group separate the *Cricetidae* into a distinct family. About 98 genera of *Muridae* and 97 genera of *Cricetidae* have been named according to this basis and the family as a whole contains over 1025 named species.

Phylogenetically the *Muridae* are considered of more recent geologic origin having evolved in late Miocene times. Their greatest diversity is in the tropical regions of South East Asia whence they are believed to have originated. They are be-

lieved to have spread in comparatively recent times into northern Palearctic regions and have not reached Nearctica except for one or two commensal forms introduced by man. The *Cricetidae* predominate in the Nearctic zone.

The *Muridae* as here defined include all the old world mice and rats, representing numerically more than one-quarter of all living mammals covering the face of the earth (Carrington, 1965).

It is difficult to generalize about such a large and diverse family. They are generally mouse-like in form with pointed slender snouts and tails which are relatively long and semi-naked bearing clearly visible annulations. Some species tend to have rather bristly or hispid pelage. They can be separated from the *Cricetidae* by the appearance of the upper cheek teeth. In nearly all forms these teeth show traces of tubercles or cusps on the grinding surface and when these are present they are arranged in three longitudinal rows (see Fig. 68). The *Cricetidae* always have only two parallel rows of cusps in the cheek teeth. The cheek teeth of the *Muridae* are never prismatic as in *Microtinae* and if their grinding surface is comparatively flat it can be seen that the lamina of harder dentine is pressed closely together and not separated into wide folds which is characteristic of the laminae in the cheek teeth of the *Cricetidae* (see Fig. 68). In the Indo-Pakistan region twenty genera of *Muridae* occur of which eight are represented in Pakistan including the Field Mice, Soft-furred Field Rats, Bandicoots and Mole Rats. None of the *Muridae* are known to hibernate.

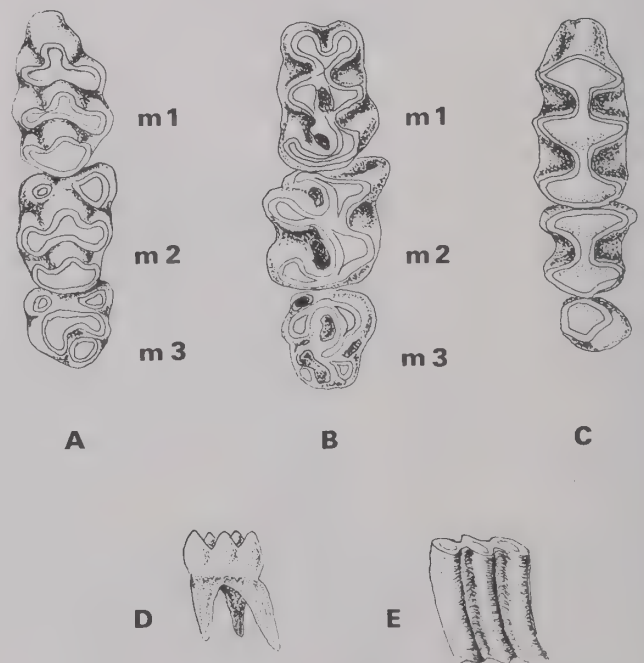


Fig. 68 Showing difference between cheek teeth of *Muridae* and *Cricetidae*.

- A. Right upper (maxillary) tooth row *Rattus rattus*.
- B. Same *Cricetulus migratorius*.
- C. Same *Meriones libycus*.

Note traces of cusps in three parallel rows in *Rattus*. Note dentition separated by wide folds of cement in *Cricetulus* and flat crowned tooth surface of *Meriones*.  
 D. Typical rooted molar of *Calomyscus baiwardi*.  
 E. Typical open rooted molar of *Rhombomys opimus*.

**Key to the Subfamily MURINAE**

Dental formula: incisors, 1/1; canines, 0/0; pre-molars, 0/0; molars, 3/3.

Generalized rodents without extreme adaptation to aquatic, sub-fossorial or arboreal existence. Skull with infra-orbital foramen quite wide to allow passage of masseter muscle. Cheek teeth three upper and three lower, always rooted and either laminate with the folds on the crowns close together or cuspidate with three clear rows of cusps (see Fig. 68). Tympanic bullae not greatly enlarged. Tail semi-naked and bearing clearly visible annulations or scaly rings.

**Key to the Families MURIDAE and CRICETIDAE**

- A. Tail semi-naked with visible annulations of scaly appearance.  
... 1
- B. Tail slender but well furred.  
... 12.
1. A. Tail noticeably shorter than head and body length.  
... 2
- B. Tail longer than head and body length.  
... 7
2. C. Ears hair covered. Soles of hind feet black skinned. Incisors longitudinally grooved.  
... *Golunda ellioti*
2. D. Ears naked or sparsely haired. Soles of hind feet greyish or pinkish-brown. Rat sized, head and body at least 82mm in length.  
... 3
3. E. Ears large, posterior or carpal pad on hind foot suppressed. Incisors slim, ungrooved and about 2mm wide across tips of upper pair.  
... Subgenus *Millardia*. 4
3. F. Ears small to medium size. Hind foot with distinct carpal pad. Incisors very massive and ungrooved and at least 4mm wide across tips of upper pair.  
... Genera *Bandicota nesokia*. 5
3. G. Ears large to medium. Hind foot with posterior heel pad. Incisors rather broad and stout and over 2 mm wide across tips of upper pair. Molars Tri-tubercular.  
... Genus *Rattus*. 6
4. A. Head and body length 90–155mm. Tail less than 80 per cent of head and body length. Dorsal fur sandy buff.  
... *Millardia gleadowi*
- B. Head and body length 120–150mm. Tail over 80 per cent of head and body length. Dorsal fur greyish brown.  
... *Millardia meltada*
5. A. Palatal foramen of skull over 8mm long. Tail 75–80 per cent of head and body length. Naked ears conspicuous. Six to eight pairs of mammae. Dorsal fur dark brown.  
... *Bandicota bengalensis*
- B. Palatal foramen of skull 5mm long. Tail under 66 per cent of head and body length. Naked ears small and inconspicuous. Four pairs of mammae only.  
... *Nesokia indica*
6. Naked ears noticeably small. Dorsal fur greyish brown. Ventrums greyish white. Naked tail thick and scaly and slightly bi-coloured. Tail 80–90 per cent of head and body length.  
... *Rattus norvegicus*
7. A. Head and body length 63–75mm. Tail over 140 per cent of head and body length. Upper lip not split.  
... *Sicista concolor*
- B. Tail longer than head and body length but less than 125 per cent.  
... 8
8. A. Head and body length under 80mm. Upper incisors with notch near tip of posterior surface.  
... Genus *Mus*
- B. Head and body length over 80mm. No notch at tip of incisors on posterior surface.  
... Genus *Apodemus*. 10
- C. As in 3(G). Head and body length over 110mm. No notch at tip of incisors.  
... Genus *Rattus*. 11
9. A. Head and body length 90–110mm. Bi-coloured tail about 90 per cent of head and body length. Hind foot 16–18mm. Dorsal fur hispid and with stiff spiny bristles on lower flanks. No pronounced notch near tip of incisors.  
... *Mus platythrix*
- B. Head and body length 65–80mm. Bi-coloured tail uniformly coloured and usually just over 100 per cent of head and body length. Dorsal fur not hispid. Ventrums white or greyish-white. Upper incisors prominently notched.  
... *Mus musculus*
- C. Head and body length over 70mm. Tail usually 95 per cent of head and body length. Hind foot 14–15mm. Dorsal fur yellowish-grey. Ventrums creamy-white.  
... *Mus cervicolor*
- D. Head and body length 55–75mm. Tail 100 per cent or more than head and body length and slightly bi-coloured. Hind foot 13–15mm. Ventrums white.  
... *Mus booduga*
10. Head and body length 84–110mm. Tail sub-equal to head and body length and bi-coloured. Usually with dorsal fur darker in spinal region.  
... *Apodemus sylvaticus*
11. A. Dorsal fur steely-grey. Ventrums pure white. Tail bi-coloured.  
... *Rattus turkestanicus*
- B. Dorsal fur varying from dark rufescent brown to grey, with ventrums usually silvery-grey to yellowish. Noticeably long tail uniformly coloured. Nasal bones less than 40 per cent of occipito-nasal length.  
... *Rattus rattus*
11. C. Dorsal fur brownish-grey. Belly silvery-grey. Tail uniformly coloured. Nasal bones more than 40 per cent of occipito-nasal length.  
... *Rattus nitidus*
12. A. Well furred tail much shorter than head and body length.  
... 13
- B. Well furred tail sub-equal or longer than the head and body length.  
... 17
13. C. With cheek pouches. Dorsal fur blue-grey with belly sharply contrasting white.  
... *Cricetulus migratorius*
- D. Without cheek pouches, and belly fur not contrasting sharply white.  
... 14



14. A. Tail shorter than hind foot. Eye and ear pinnae almost invisible.  
... *Ellobius fuscocapillus*  
B. Tail approximately one and a half times length of hind foot. External ear pinnae reduced but clearly visible averaging 9–11mm in length. Females with 6 mammae.  
... Genus *Hyperacrius* (15)  
C. Tail approximately twice the length of hind foot. Ears conspicuous and well furred, averaging 13–17mm in length.  
... Genus *Alticola* (16)
15. A. Ear usually 9mm or less. Head and body length 107–130mm. Dorsal fur very dark blackish-brown.  
... *Hyperacrius wynnei*  
B. Ear usually 11–12mm. Head and body length of 90–110mm. Dorsal fur dark reddish-brown.  
... *Hyperacrius fertilis*
16. A. Tail less than 25 per cent of head and body length.  
... *Alticola stoliczkanus*  
B. Tail always more than 25 per cent of head and body length.  
... *Alticola roylei*
17. A. Slender build with hind leg elongated. Head and body length under 90mm. Tail over 120 per cent of head and body length. Tympanic bullae inflated and usually over 28 per cent of occipito-nasal length.  
... Genus *Gerbillus* (18)  
and *Calomyscus*  
B. Robust build with hind leg not noticeably elongated. Head and body length over 100mm. Tail usually about 110 per cent of head and body length. Tail uniformly coloured basally with terminal tuft of longer black hairs.  
... Genus *Meriones* (20)  
and *Rhombomys*  
C. As in B with tail dark brown dorsally and ventrally with paler buff band down each side. Soles of feet naked. Ears 22–25mm long.  
... *Tatera indica*
18. A. Large ears 17–20mm in length. No white spot behind ears or eyes. Tail bi-coloured and with mixture of white hairs in terminal tuft.  
... *Calomyscus bailwardi*  
B. Small ears 13–17mm in length. With white patch behind ears and eyes. Soles of hind feet hairy. Dorsal fur reddish-tan.  
... 19  
C. As in B with soles of hind feet naked. Dorsal fur sandy-buff or yellowish-brown.  
... *Gerbillus nanus*
19. D. Head and body 75–100mm. Tail 120–145mm averaging proportionately longer than *G. cheesmani*.  
... *Gerbillus gleadowi*  
E. Head and body 89–105mm. Tail 110–140mm and averaging proportionately shorter than *G. gleadowi*.  
... *Gerbillus cheesmani*
20. A. Upper incisors with single longitudinal groove with sole of hind foot naked.  
... (21)  
B. Upper incisors with single longitudinal groove with sole of hind foot hairy except for small heel patch.  
... (22)  
C. Upper incisors with two longitudinal grooves. Robust build.  
... (23)
21. D. Ventrums creamish white. Ears noticeably small 10–12mm long. Claws blackish.  
... *Meriones hurrianae*  
E. Ventrums pure white. Ears large 21–24mm. Claws brownish or horn coloured.  
... *Meriones persicus*
22. A. Ears medium size 16–22mm. Claws black. Tail usually slightly longer than head and body length, and with well developed terminal tuft. Tympanic bullae 34 per cent of occipito-nasal length.  
... *Meriones libycus*  
B. Claws brown or horn coloured. Tail usually 80–90 per cent of head and body length and with poorly developed black terminal tuft. Tympanic bullae enlarged – 38 per cent of occipito-nasal length.  
... *Meriones crassus*
23. Ears small 13–17mm. Large size and robust build. Terminal tail tuft often dark-brown rather than black. Molars open rooted and continuously growing.  
... *Rhombomys opimus*

### Genus APODEMUS Kaup, 1829

This is a Palearctic genus containing six to seven recognized species. They are generalized mice lacking any very specialized features and being adapted to all types of habitats. Not showing any distinctive features they have proved a difficult genus for the taxonomists. They can be differentiated from all other *Muridae* by examination of the first and second upper cheek teeth which bear a posteriointernal cusp. Their fur is never hispid. They are largely terrestrial mice but are agile and well able to climb.

### Key to the Genus APODEMUS

Medium sized mice with the tail roughly equal to the head and body length and the hind foot with the outer toes not greatly reduced in length. Ear large and semi-naked. Upper cheek teeth bearing three rows of roughly equal cusps.

### Key to the Pakistan Species of APODEMUS

Head and body length over 80mm. Tail not prehensile. Body fur soft and not hispid. No notch at tip of inner surface of incisors. Dorsal fur darker in spinal area.

... *Apodemus sylvaticus*

### APODEMUS SYLVATICUS

*Apodemus sylvaticus* Linnaeus, 1758; Wood Mouse or Field Mouse (see Illustration 74).

**Description:** In general appearance this Field Mouse looks like a rather large House Mouse with the same semi-naked tail and sharp pointed muzzle. In the hand it will be noticed that the feet are white and that the tail is rather better covered with short hairs than is the case with *Mus musculus*. The tail is also markedly bi-coloured, the dorsal surface being brownish grey and the ventral surface whitish. *Mus musculus* generally has the tail uniformly coloured pinkish grey. In specimens from Pakistan the fur on the belly, lower throat and cheeks is clear greyish-white sharply defined from the darker brown colouring of the upper



Illustration 74 *Apodemus sylvaticus*: Common Field Mouse.  
(Based on fresh killed specimen collected in July from  
Jabba Valley, Swat Kohistan.)

parts. Van den Brink in his *Field Guide to European Mammals* (1967) indicates that *A. sylvaticus* can be separated from *A. flavicollis* by the gradual merging of the brown upper parts with the pale grey belly, but this is not a consistent character in Pakistan specimens. The tail generally slightly exceeds the head and body in length. As indicated in the key the upper incisors lack any notch or step near the tip of their inner surface which characterizes the genus *Mus* (see Fig. 69). They are coated with orange enamel. The eye is large and bright and the ears are practically naked, prominent and rounded in outline (see Fig. 70).

There is some variation in fur colouration; generally the dorsal fur is typically greyish-brown. Some specimens from the Murree Hills show an indistinct mid dorsal stripe of darker hairs. This dark stripe is less noticeable in specimens collected further to the west from Hazara District. Specimens from the more northern regions tend to be paler and more rufescent in dorsal pelage and there is a possibility that a very distinct subspecies occurs in the extreme northern mountain desert regions. A specimen from Phandar in Northern Gilgit in the Smithsonian National Museum is a very pale isabelline brown dorsally, and another specimen in the Bombay Natural History Society collection from Drosh in Chitral has exactly similar fawn colouration. These remarkably pale specimens appear to be similar to *Apodemus flavicollis wardi* originally described by Wroughton.

Quite a number of specimens from the Murree Hills and the southern part of Hazara District show a small longitudinal yellowish or rusty coloured line of hairs in the region of the sternum and lower throat. A similar mark is often present in European forms of *Apodemus sylvaticus* (Van den Brink, 1967).

*A. sylvaticus* is sometimes sympatric with *Sicista concolor* as well as *Mus musculus* and could be confused with the former species. *A. sylvaticus* always has a comparatively shorter tail than *S. concolor* with a more pointed muzzle

and a divided upper lip and relatively bigger ears. The belly fur of *A. sylvaticus* is much whiter than that of *S. concolor*. Compared with the European population, Pakistan specimens of *A. sylvaticus* are large in size, having comparatively short tails. Dimensions of twenty two specimens from Pakistan territory is as follows: the head and body average 91mm. ( $3\frac{9}{16}$ in.) (range 84–112mm), tail 95mm ( $3\frac{3}{8}$ in.) (range 83–112mm), hind foot 21mm ( $\frac{7}{8}$ in.) (range 19.3–23mm) and ear 15mm ( $\frac{9}{16}$ in.) (range 13–17mm).

Average weight of twelve adult specimens from Hazara district was 39.4g.

**Distribution and Status:** The scientific name of this Field Mouse is misleading, since it is by no means confined to woodland and is highly adaptable ecologically. It occurs throughout the northern mountain areas of Pakistan from arid rocky mountain slopes up to 3100m (10,000ft) elevation and even in subalpine scrub and meadow up to 3600m (12,000ft) elevation in the southern moister Himalayan ranges. It also occurs in Himalayan dry temperate coniferous forest and moist temperate forest down to about 1850m (6000ft) elevation. In the winter season they do not hesitate to enter villages and to frequent deserted buildings.

It occurs quite abundantly throughout Gilgit, Swat, Chitral and the northern parts of Hazara District but it does not seem to have spread as far south as the Safed Koh Range or Takht-e-Suleiman which would seem to afford equally suitable steppic forest conditions. It has not been recorded in Baluchistan and its distribution would seem to indicate an invasion of Pakistan from northern Palearctic regions which is further corroborated by its distribution in Afghanistan and Iran. It has been trapped in Chitral in holly oak (*Quercus ilex*) scrub forest, in Deodar (*Cedrus deodara*) forest in Dir and alongside alpine streams above the tree line in the Kaghan Valley as well as in Himalayan moist temperate forest. In Gupis District of Gilgit it



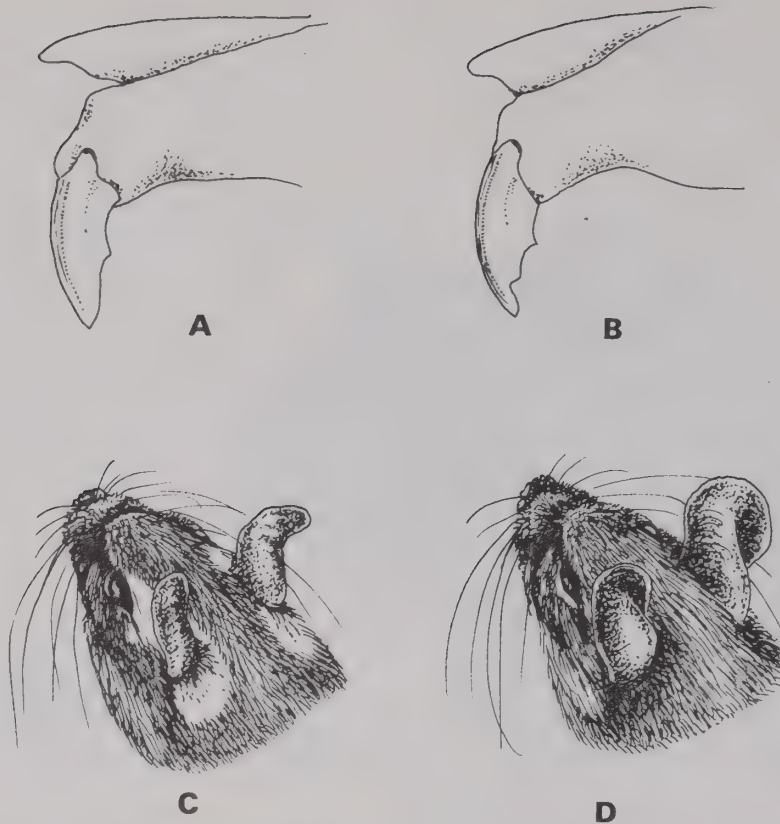


Fig. 69 Showing useful field characters for identifying rodent genera:

A. *Apodemus sylvaticus*.

B. *Mus musculus*. Note wearing of distinct notch on inner surface of tip of incisor of *Mus* species, which is absent in *Apodemus* species.

C. Head of *Gerbillus* species showing characteristic white patches behind eye and ear.

D. Head of *Rattus leadowi* lacking white spots behind eye and ear.

Note that *Gerbillus nanus* and *Rattus leadowi* have closely similar body size and pelage colouration.



*Apodemus sylvaticus*

Distribution Map 91 Wood or Field Mouse.

occurs on comparatively arid rocky mountain slopes where there is no forest cover.

In adjacent countries it occurs throughout Tadzhikistan, North Kirghizia, the Altai mountains and Turkestan (Flint et al., 1965 and Bobrinskii et al., 1965). In Afghanistan it is more or less restricted to the higher mountainous regions of Nuristan, Paghman and Peiwar in the extreme north east (Niethammer, 1969B and Hassinger, 1968). In Iran it seems confined to the Elburz and Zagros mountains in the north as well as to adjacent portions of the Caspian Sea coastal plain (Lay, 1967). It occurs eastwards throughout the inner higher Himalayan ranges from Ladakh through Nepal and Assam and northern Burma (Ellerman, 1961, Part II).

Though numerically abundant and widespread it occurs in relatively sparsely populated arid mountainous regions and there is no definite evidence of its being a serious economic pest, though it may damage newly planted crops in upland valley regions as well as destroying seedling conifers.

**Biology:** The Field Mouse is a nocturnally active rodent which normally lives well away from human habitations. They are quite gregarious and several adults have been recorded as sharing the same burrow. They dig their own burrow system, often constructing therein a nest woven

from soft grasses which is concealed beneath the roots of a tree or in an enlarged underground chamber. Such nests are used for daily shelter as well as by the females for rearing their young. In western Europe this Field Mouse has been recorded as building nests above ground woven from grass fibres and moss.

They are mainly terrestrial in feeding activity but are very agile and well able to clamber amongst bushes and tall herbage. The tail is not prehensile. Their diet is mainly herbivorous but they will eat all kinds of seeds, berries and wild fruits as well as insect larvae and crustacea found amongst the leaf litter. In Europe in winter, succulent grass roots comprise an important part of their diet (Southern, 1964). In Europe they have been recorded as feeding on toadstools. They carry seeds and berries into their underground burrows for food storage especially towards the end of the summer and since they do not hibernate these food caches are probably essential to survival. Similar regular food storing habits have not been observed in the genus *Mus*, with the possible exception of *Mus musculus*.

The Field Mouse in the Himalayas probably produces four or five litters per year and there is no evidence that they breed outside of the spring, summer and the autumn months. Juvenile specimens have been trapped by me in the first week of July in the Kaghan Valley. The gestation period is 25 to 26 days (Corbet, 1966). Females have six to eight mammae and the average litter size is between five and six, though up to nine young have been recorded. Out of six females collected in Iran which were pregnant, the average number of foetuses was 5.4 (Lay, 1967). Females are believed to be sexually mature when 12–14 weeks old. The young are born blind and naked. By the tenth day they are well covered with fur and almost one-quarter the size of the mother. A female with young does not permit any male to enter the nest chamber but outside of the breeding season they will share the same shelter. In Europe the potential life span is about two years with the mean expectancy from the time of weaning at only six months (Corbet, 1966).

In the Himalayas the principal predators of this Field Mouse in forest regions are the Collared Pigmy Owlet (*Glaucidium brodiei*) and the Indian Scops Owl (*Otus scops*). It must also fall prey to such carnivores as the Leopard Cat (*Felis bengalensis*) and the Yellow Throated Marten (*Martes flavigula*) in forest areas. In Iran five specimens of this Field Mouse were found in the stomach of one Jungle Cat (Lay, 1967). *Felis chaus* does not occur in regions where the Field Mouse is at present known within Pakistan.

#### APODEMUS FLAVICOLLIS

*Apodemus flavicollis* Melchior, 1834; Yellow-necked Field Mouse.

Synonym *Apodemus griseus* (Bombay Natural History Society Collection)

**Status in Pakistan:** J. R. Ellerman, in the *Fauna of British India* series (1961) assigned some Pakistan specimens of *Apodemus* to *A. flavicollis*. In the collections of the British Museum and Bombay Natural History Society there are a number of specimens of Field Mouse collected from Pakistan in the early twentieth century which were assigned to *A. flavicollis*. J. R. Ellerman (1961), whilst admitting that the population of the two species seemed to be sympatric, tried to separate them on the basis of skull sizes, *A. flavicollis* being larger. Both M. S. Siddiqi in his *Check-*

*list of Pakistan Mammals* (1961) and Z. B. Mirza (1970) include *A. flavicollis* as a separate species occurring in Pakistan. It seems more logical to treat the entire Pakistan population as belonging to one species *Apodemus sylvaticus*. The Field Mouse population in adjacent Russian territory is entirely assigned to *A. sylvaticus* (Sokolov, 1963). In a detailed investigation by Dr. Niethammer (Niethammer, 1969) of 111 specimens collected from various parts of Afghanistan there was no consistent morphological basis for separating the population into two species and ecologically the entire Field Mouse population seemed to point to *A. sylvaticus*. In Iran all the specimens of *Apodemus* collected by the Street Expedition were assigned to one species *A. sylvaticus* (Lay, 1967). Even in western Europe, it is well known that *A. sylvaticus* is ecologically more adapted to living in dry and comparatively hilly regions whilst *A. flavicollis* requires more humid conditions and is much more restricted to a forest biotope. The habitat preferences of the Field Mouse population of Pakistan therefore lends further support to the conclusion that the entire population should be assigned to *A. sylvaticus*.

#### Subgenus MILLARDIA Thomas, 1911

The three species within this sub-genus are called Soft-furred Field Rats and are confined to India, Burma, Ceylon and Pakistan. Ellerman and Morrison-Scott (1951) placed *Millardia* in a separate genus, but these field rats are closely similar to the true rats of the genus *Rattus* having only a minute difference in the pads of the soles of the feet. Hence, J. R. Ellerman in the *Fauna of British India* series (1961) subsequently considered that *Millardia* should be ranked only as a subgenus of *Rattus*. As their name implies they have soft lax fur and semi-naked tails, and inhabit cropland and waste areas away from human habitation.

#### Key to Subgenus MILLARDIA

Medium to smaller sized rats with large ears (equal to hind foot in length) and carpal pad on hind foot suppressed. Fifth or outer toe very short. Upper incisors smooth, ungrooved and slim, the pair being about 2mm wide across tip.

#### Key to the Pakistan Species of MILLARDIA

(i) - Small size and pale sandy yellow body fur. Head and body length 85–115mm with tail usually less than 80 per cent (66–85mm) of head and body length. Females with 3 pairs of mammae.

... *Rattus gleadowi*

(ii) - Larger size with pale greyish fawn body fur. Head and body length 115–150mm and tail over 80 per cent of head and body length (111–125mm). Females with 4 pairs of mammae.

... *Rattus meltada*

#### RATTUS MELTADA

*Rattus meltada* Gray, 1837; Soft-furred Field Rat or Metad (see Illustration 75).

Synonym *Millardia meltada pallidior* Ryley, 1914

**Description:** Typically ratlike in appearance, this Metad differs slightly from other species of the Genus *Rattus* in hav-



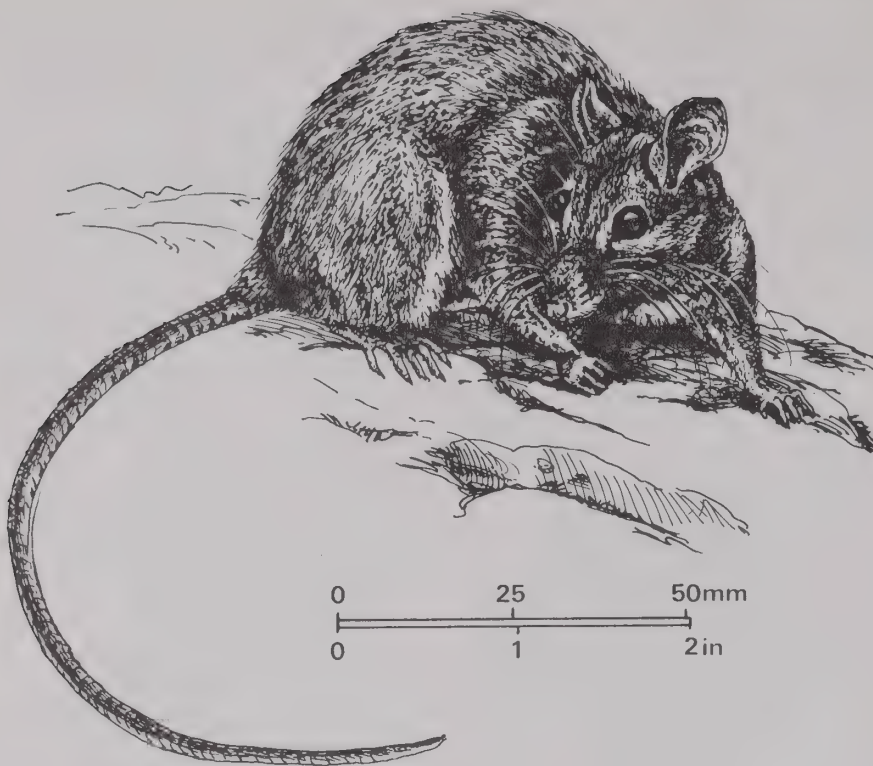


Illustration 75 *Rattus meltada*: Soft-furred Field Rat or Metad. (Based on captive female specimen collected late March from Kallar Kahar, Punjab.)

ing very large round ears, a comparatively short bi-coloured tail and rather specialized hind feet with the posterior pads of the sole entirely absent or greatly suppressed (vestigial). The hind feet are sturdy and roughly equal in length to the ear, with five toes. The fifth or outer toe is noticeably short being roughly equal to the hallux. The tail is sparsely haired and shows clearly visible annular rings. It is blackish-grey dorsally and pinkish-white ventrally, and is generally about 80–90 per cent of the head and body length. The muzzle is relatively more sharply pointed than that of *Rattus norvegicus* and even compared to *Rattus rattus* their eyes are larger and more prominent and the naked ears also rounded and more prominent.

In size they average smaller than *Rattus rattus* with the head and body length varying between 120–150mm ( $4\frac{3}{4}$ – $5\frac{7}{8}$  in.) in length and the skull (occipitonasal length) over 28mm ( $1\frac{1}{8}$  in.). The dorsal fur as well as the upper part of the head is characteristically sandy-grey with slight buffish tinges, being much paler and less brown than either *R. rattus* or *R. norvegicus*. The throat and belly fur is pure white or pale greyish white in some specimens. There is a sprinkling of longer guard hairs throughout the body of the Metad and the lower part of the muzzle is often whitish. Females have eight mammae and this is an important diagnostic point in separating *R. meltada* from the other *Millardia* species. Dimensions of 22 specimens from the Punjab and Sind are as follows: head and body length average 129mm ( $5\frac{1}{16}$  in.) (range 113–147mm) with the tail average 112mm ( $4\frac{3}{8}$  in.) (range 101–131mm), the ear average 22mm ( $\frac{7}{8}$  in.) (range 20–25mm) and the hind foot 25mm (1 in.) (range 23–28mm).

Both pairs of incisors are rather slender and lack any longitudinal groove. They are covered with pale orange or yellow enamel. The cheek teeth (molars) are sharply cuspidate,

indicating that they are well adapted to a graminivorous diet. The palatal foramen are very long and slender in both this species and *R. gleadowi*.

**Distribution and Status:** It appears from the rather restricted distribution of the Soft-furred Field Rat in Pakistan that it is characteristically an Oriental faunal zone species which has entered the more arid north-west mainly in the better watered tracts along the Himalayan foothills in the north east as well as in the extreme south of Sind along the coastal plain from Kathiawar (see Chapter 2). As long as there is sufficient vegetative cover, it will inhabit quite dry rocky hills as well as flat alluvial plains on the borders of cultivation. Though it avoids purely sandy areas, in southern Sind it certainly tolerates quite saline areas having a predominantly halophytic type of vegetation.

In Pakistan the Soft-furred Field Rat appears to have a rather restricted distribution being mainly confined to southern Sind and the north eastern part of the Punjab. In Sind it is fairly widespread in Tharparkar and Thatta districts. It has been collected near Malir and near Mirpur Sakhrro and also Umerkot in Thatta District and is plentiful in the rice fields around Sujawal. It does not occur in the North West Frontier Province or in most parts of Baluchistan though it has extended westwards through the main valley of Las Belas and southern Kalat (J. A. W. Anderson, pers. comm.). To the north it occurs around Bahawalnagar District where it has been trapped in sugar-cane fields, also in Changa Manga forest plantation and the outskirts of Lahore. It seems to have spread fairly recently, southwards to Lyallpur District where it is fairly common, especially in sugar-cane fields. (Dr. Mirza Azhar Beg, 1973, pers. comm.).



Distribution Map 92    Soft-furred Field Rat or Metad.

It has been collected in Sialkot District near Kalian as well as in Gujrat District and extending westwards across the Salt Range to Kallar Kahar and the Soon Valley. There are no records of its occurrence from the North West Frontier Province or any of the Himalayan regions.

Outside of Pakistan, this Field Rat is confined to India, extending from Bihar in the north east down through the Deccan and into Ceylon. It is particularly plentiful in Kathiawar and Gujrat, and also in Punjab around Ludhiana where it is considered a serious pest of groundnut crops.

**Biology:** Until recent studies conducted by the Punjab Agricultural University at Ludhiana in India, remarkably little has been recorded about these uniquely endemic Field Rats. Even S. H. Prater in the most recent account of Indian mammals (1965) largely repeats what was recorded by Dr. Jerdon (1874) in describing the field characteristics and habits of Metads. They are nocturnal in activity and spend the day concealed underground. They are considered rather poor burrowers, preferring to make use of natural crannies in loose stone walls and embankments, or even natural cracks in the soil. They are not particularly colonial though two or three individuals may occupy burrows located in the same vicinity. Though *Rattus meltada* can be found in the same terrain as the Desert Jird (*Meriones burrianae*) where there are areas of waste land or saline flats away from cultivation, it seems to prefer areas with more vegetative cover such as grassy embankments and moister areas on the side of canals or forest plantations in the same kind of terrain as *Nesokia indica*. I have found that *Rattus meltada* particularly favours burrowing in the base of cactus or euphorbia hedges in Malir and I have trapped it in the Salt Range along the base of Prickly Pear hedges (*Opuntia dillenii*) as well as in stone embankments dividing the small terraced patches of cultivation.

It is not known whether *Rattus meltada* habitually build a nest chamber in their underground burrows, but it seems likely since a captive specimen in the possession of the

author soon made a very neat globular nest out of chewed pieces of newspaper, though it was not pregnant. Moreover *R. gleadowi* regularly constructs nest chambers in their burrows.

The diet of *R. meltada* consists partly of seeds and partly vegetable matter. With their sharply cuspid molars they are well adapted for separating the hard pericarps of grass seeds as well as the tough covering of *Chenopodiaceae* nuts. Like *R. gleadowi* they can live in regions where they must subsist without drinking free water and must obtain their requirements from succulent vegetation. In parts of south India this Metad sometimes increases to plague proportions, at which time it does considerable damage to cultivated crops such as sorghum (Jerdon, 1874). They also eat the seeds of pulse crops and even cotton seeds which are shunned by most other rodents because of the toxic gossypol which they contain. Though these Field Rats are quite widespread in southern Sind, there is no evidence of their having ever become serious crop pests as has been the case with *Bandicota bengalensis* (Wagle, 1927). However preliminary studies in the rice crop of Sujawal area by Dr. G. W. Fulk in 1974 indicated that this rat feeds mainly on rice grains as the crop ripens.

*R. meltada*, like other *Rattus* species is typically early maturing and prolific though not quite so fecund as the House Rats or Bandicoots. A captive specimen of *Rattus meltada* produced a litter of six in November whilst S. H. Prater records (1965) litter sizes of up to eight. Detailed studies in Ludhiana (Punjab, India) indicated that breeding extends from March to November but with peak reproductive activity from August to October. Litter sizes varied from 3 to 10 with a mean of just under six. Under laboratory conditions females had a regular oestrus cycle of four to five days and a gestation period of 21 days (Bindra et al., 1968).

*R. meltada* is probably preyed upon by foxes (*Vulpes* spp.), and mongooses (*Herpestes* spp.) as well as the Spotted Owl (*Athene brama*) and the Jungle Cat (*Felis chaus*).

## RATTUS GLEADOWI

*Rattus gleadowi* Murray, 1885; Sand-coloured Rat.

Synonyms *Mus gleadowi* Murray, 1885

*Grypomys gleadowi* Thomas, 1911

**Description:** *Rattus gleadowi* is a distinctly smaller Field Rat than *R. meltada* with a paler colouration, and it is adapted to a dryer semi-desert biotope. Specimens first collected from Tharparkar and near Karachi were first described as a distinct genus *Grypomys* on the basis of having only six mammae (Thomas, 1911). The average dimensions of eleven specimens from Sind and Baluchistan is 90mm (3 $\frac{2}{16}$ in.) (range 80–115mm), head and body length with the tail 78mm (3 $\frac{1}{16}$ in.) (range 68–93mm) and the ear 19mm ( $\frac{3}{4}$ in.) (range 18–32mm) and the hind foot which generally equals the ear in length averaging 19mm ( $\frac{3}{4}$ in.) (range 18–20mm). The skull averages less than 27mm (1 $\frac{1}{16}$ in.) occipitonasal length. It is thus noticeably smaller than that of *R. meltada*. It is further separable by having a comparatively shorter tail, which averages not more than 80 per cent of the head and body length and in typical adult specimens varies from 73–83mm (2 $\frac{7}{8}$ –3 $\frac{1}{4}$ in.) in length. Secondly the females possess only six mammae, having one pair less than *R. meltada*.

When observed in the field the most striking thing about this rat is the colour of the upper body parts. The fur is a pale sandy-buff colour similar in tone to the body fur of *Gerbillus nanus* with which it can be sympatric. Its fur is





Distribution Map 93 Sand-coloured Rat.

dense and rather lax whereas *G. nanus* has comparatively sleek stiff body fur. The lower parts of the head, throat and belly are pure white and never greyish-white as in the belly of *R. meltada*. The tail is sparsely haired showing a scaly semi-naked appearance and is distinctly bi-coloured. The incisors are more slender than *R. meltada* and they are ungrooved and coated with pale orange enamel on their outer surface. The molars are similar to *R. meltada* in being markedly cuspidate. In the field the Sand-coloured Rat can at once be separated from the *Gerbillus nanus* by its comparatively larger ears and sparsely haired tail lacking any terminal tuft of longer hairs, as well as the absence of white patches behind the eyes and ears characteristic of *Gerbillus* species (see Fig. 69).

**Distribution and Status:** Whilst the Soft-furred Field Rat may inhabit cropland and the edges of water channels, *R. gleadowi* is always found in semidesert areas away from irrigated cultivation. In Sind it is typically associated with shifting sand-dune areas alternating with clay flats, often under rather saline conditions. On the western side of the Indus it is found on stony hillsides and near the banks of gravel washes, but does not seem to frequent more rocky mountain slopes.

This Field Rat was originally collected from Clifton in Karachi, the first specimens being described in 1885 by James A. Murray, the Curator of Karachi Museum. It occurs mainly in Tharparkar District and southern Sind, spreading northwards up the west or right bank of the Indus. It has been collected in Dera Ghazi Khan District, around Hyderabad, Pithoro and also in northern Baluchistan around Loralai. It has also been collected from the North West Frontier Province from Kirgi in south Waziristan. Surprisingly there are no records of this Field Rat within Pakistan territory east of the Indus River north of Hyderabad. Outside of Pakistan it occurs in Kathiawar and the Rann of Kutch, and sparsely up to Jodhpur in Rajhastan, all regions in western India. Undoubtedly it is rather restricted in distribution in

Pakistan and nowhere plentiful. It inhabits dry sandy or rocky desert areas and is of no economic importance.

**Biology:** Even less has been recorded about this rat than *R. meltada*. It is known that they are nocturnal and not particularly colonial, their burrows being widely scattered. Generally these are excavated under the roots of some bush or saltwort plant (*Chenopodiaceae*). The burrows are quite short, extending usually not more than 45.7–61 cm (18–24 in.) below ground at an angle of approximately 45° and terminating in a circular nest chamber lined with grass (JBNHS Report No. 3, 1912). There is a vertical tunnel leading from the other side of this nest chamber to the surface, the top exit of which is sometimes stuffed with a pad of grass.

They are largely graminivorous in diet, but also feed on young shoots and buds when available and judging from the localities where they occur they must be able to exist without any free drinking water, obtaining all their needs from succulent vegetation or the metabolic oxidation of carbohydrates. Since they are often associated with saline tracts it seems probable that they have considerable renal concentrating ability and are physiologically adapted to cope with a high salt intake.

Presumably they produce smaller litters on average than *R. meltada* since the females have fewer pairs of mammae. During the Mammal Survey of Kathiawar C. A. Crump recorded (JBNHS Report No. 10, 1913) litter sizes varying from three to five during December and January. Live caught specimens collected during August and September from Pali in Rajhastan, delivered 2 and 3 offspring shortly after capture (Prakash et al., 1970). In one burrow a female with three newly born young also had a brood of three young which were three-quarters adult size occupying the same nest. But there is no evidence that they do not breed at other months of the year also.

The Saw-scaled Viper (*Echis carinatus*) and the Diadem Rat Snake (*Sphalerosophis diadema*) (Minton, 1966) both occur in the same desert areas as the Sand-coloured Rat and probably prey upon this species. It is likely that Grey Mongooses (*H. edwardsi*) and Foxes (*Vulpes* spp.) feed on this Metad.

*R. meltada* occurs in the same biotope with *Meriones burrianae* in Sind and *Meriones libycus* in parts of Baluchistan.

### Genus RATTUS Fischer, 1803

This is a very large genus and over 570 different forms have been described. Most of these come from the tropical regions of South East Asia and Africa, but two species have spread to almost every part of the world, largely through man's agency. These two species *Rattus norvegicus* and *R. rattus* are the most highly successful and widespread mammals in the world today except possibly man. They are partly commensal if not actually parasitic on man, so that it is not surprising that they have been studied and described in great detail. Known as the Black Rat or Roof Rat, *Rattus rattus* is believed to have originated in the far east and is the Common House Rat of India. It may possibly have originated as a forest species but it was the first to spread into Europe and across to the New World via the agency of ships. The Norway Rat or Brown Rat (*Rattus norvegicus*) probably originated somewhere in Asia Minor or Japan and is much more of a fossorial species. Being larger and more aggressive than the Black Rat and better adapted to cold climates, it has now spread more extensively than the former. Other species within the genus may be partly

commensal whilst some are completely arboreal and confined to natural forest in tropical areas.

Anatomically, the genera *Rattus* and *Mus* are almost identical, both representing generalized mouse-like rodents without any special features. Members of the genus *Rattus* lack any posterointernal cusp to the upper molars which distinguishes them from the genus *Mus*. Moreover they are mostly larger species than members of the genus *Mus*. Beyond this there is much size and colour variation within both genera.

Pakistan has three, possibly four, species within its limits, all of which are very similar in general external appearance and habits. (A specimen collected near Lahore by the University of Maryland Expedition has been assigned to *Rattus fulvescens* (Gray, 1847).)

### Key to the Genus RATTUS

Typically medium to large sized rodents with the body thick set and tail very sparsely haired. Head and body 150–260mm. Ear relatively small and sparsely haired. The upper cheek teeth are less than one fifth of occipitonasal length with first molar always less than the tooth row, in length.

... *Rattus*

### Key to the Pakistan Species of RATTUS

(i) Polymorphic species with ventrum varying from pure white through fulvous to silvery-grey. Tail always longer than head and body length and uniformly coloured. Ear comparatively large but shorter than hind foot. Head and body 150–180mm. Nasal bones always less than 40 per cent of occipito-nasal length.

... *Rattus rattus*

(ii) Head and body length 150–210mm. Dorsal fur always markedly greyish-brown with ventrum pure white and tail bi-coloured being paler on ventral surface. Tail always longer than head and body.

... *Rattus turkestanicus*

(iii) Head and body length 110–130mm. Tail usually uniform coloured with dorsal body fur dark brown to brownish-grey. Belly silvery-grey. Nasal bones long and usually more than 40 per cent of occipito-nasal length.

... *Rattus nitidus*

(iv) Large size. Head and body length 180–275mm. Tail usually shorter than head and body length and markedly scaly and slightly paler on ventral surface than dorsal. Ears comparatively small. Upper incisors broad and stout measuring about 3mm across their tips. Molars tri-tubercular. Hind foot with posterior heel pad.

... *Rattus norvegicus*

### RATTUS RATTUS

*Rattus rattus* Linnaeus, 1758; Roof Rat, or Black Rat also known as House Rat and Alexandrian Rat.

**Description:** A rather large thickset rodent with a relatively long semi-naked scaly tail, long pointed muzzle and divided upper lip, round naked ears and relatively small black eyes. There are five digits on the hind feet and four on the fore-feet. Compared with the mice of the Genus *Mus* they have relatively bulky bodies and small heads.

The tail is uniformly dark grey brown without being paler on the ventral surface and is invariably slightly longer than the head and body length.

There is much variation in size. Six specimens from the Punjab having head and body length 150–166mm (average 163mm) ( $5\frac{7}{8}$ – $6\frac{5}{16}$  in.) with the tail 187–202mm ( $7\frac{3}{8}$ –8 in.) (average 209mm) in length, the hind foot 32–37mm ( $1\frac{1}{4}$ – $1\frac{3}{8}$  in.) (average 34mm) and the ear 21–22mm ( $1\frac{1}{16}$ – $\frac{7}{8}$  in.) (average 22mm) in length. Five specimens from the grain godowns in Karachi tend to be larger, varying from 163 to 189mm ( $6\frac{3}{8}$ – $7\frac{7}{16}$  in.) head and body length, with the tail 221–239mm ( $8\frac{5}{8}$ – $9\frac{3}{8}$  in.) long, hind foot 34–41mm ( $1\frac{3}{8}$ – $1\frac{5}{8}$  in.) and ear 21–25mm ( $1\frac{3}{16}$ –1 in.). A large male trapped from the TPX rail depot weighed 178g ( $6\frac{1}{4}$  oz).

Females have 10 to 12 mammae. A large number of different subspecies have been described from the Indo-Pakistan subcontinent. Ellerman and Morrison-Scott (1951) name 53 subspecies from the Palearctic and Indian region alone. At least four of these seem to be represented in the Pakistan population, according to specimens in the museum collections of the Bombay Natural History Society and the British Museum. Broadly speaking these four subspecies can be separated according to the colour of the belly fur or ventrum. All of them have dark greyish-brown dorsal fur with a scattering of longer guard hairs. Some individuals are more rufescent in body colour and others more greyish, but despite its trivial name there do not appear to be any really black forms occurring in Pakistan. The four subspecies may be distinguished as follows:

### Subspecies of RATTUS:

- (i) *R. rattus rattus*: the belly fur is dark sooty-grey.
- (ii) *R. rattus alexandrinus*: the belly fur is greyish-black.
- (iii) *R. rattus rufescens*: the belly fur of this subspecies has a distinctly rusty or fulvous tinge.
- (iv) *R. rattus frugivorus*: the belly fur of these specimens is a pale cream colour.

All the above forms seem to occur in the Karachi area, including specimens with pale canary yellow bellies, so these subspecies do not seem to be geographically separable.

**Distribution and Status:** The Roof Rat is largely a commensal of man and associated with villages and human habitations throughout Pakistan except for the inner ranges of the Himalayas where it is replaced by *Rattus turkestanicus*. It is found from the sea coast up to 1980m (6500ft) elevation in the Murree Hills. It is not much of a burrower, preferring to live in crevices, in holes, and under the eaves of roofs. It will inhabit warehouses as well as isolated adobe (mud-walled) hutments.

The Roof Rat is the most widely distributed member of the family Muridae in Pakistan, though it may not be as numerically abundant within restricted localities as some of the field rats or gerbils. It occurs in all the larger towns and villages throughout Baluchistan, Sind, Bahawalpur, the Punjab and the North West Frontier Province. It has been trapped in Swat, Dir and Murree in the Himalayan regions. I have trapped it at 1820m (6000ft) from a remote hamlet on the slopes of the Chiltan Hills in Baluchistan as well as from the summit of the Suleiman Hills in Dera Ghazi Khan.

From a purely economic viewpoint and its food-destroying habits this species is probably the most important pest in Pakistan amongst the class of Mammalia.

**Biology:** As is well known, these rats are practically omnivorous in feeding habits. They depend heavily upon food grains collected and stored by man as well as his refuse and discarded garbage. They will eat all kinds of green vegetable





*Rattus rattus*

Distribution Map 94 Roof Rat or House Rat.

food, seeds, grains, fruits, meat, insects and even leather and candle wax. Rats damage and destroy a lot more food than they actually consume, and this species undoubtedly does enormous damage to stored grains, particularly wheat, throughout the villages of Pakistan. Apart from their harmfulness in destroying stored grains, they are also vectors for several diseases dangerous to man, because of their close association with his dwelling places. Rat fleas collected from this species are known to be vectors for such fatal diseases as bubonic plague, scrub typhus, trichinosis and even rabies.

Rats are partially social, and large numbers appear to share the same interconnected burrow system. They are comparatively bold and fearless rodents with an extremely inquisitive disposition. This probably accounts partly for their success in utilizing a wide variety of foods and in colonizing a variety of regions. Many laboratory experiments conducted upon domesticated strains of this rat have clearly demonstrated their intelligence and ability to learn (Tinbergen, 1966).

The fecundity of this rat and indeed most *Rattus* species is phenomenal. Females are capable of producing six to seven litters a year comprising up to 12 young at a time and breeding can occur in every month of the year. Studies in Lyallpur region indicated that there might be two peak breeding seasons, one at the end of the monsoon in September and a second lasting from January to March. In this study, litter sizes varied from four to nine and were comparatively smaller than have often been recorded for the species elsewhere (Taber, 1967). An earlier study indicated that litter size averages only six in Pakistan and that an average of three litters a year are produced but it seems doubtful whether this was based on a detailed examination of field caught specimens (Akhtar, 1960).

Females first breed when they are about 12 weeks of age and the newly-born young are blind and naked at birth. They open their eyes on the fifth or sixth day and develop very quickly. In the wild these rats probably do not live beyond two years.

This rat no doubt falls victim occasionally to mongooses (*Herpestes* spp.), as well as to the larger more venomous

snakes such as the Cobra (*Naja naja*), and to the Barn Owl (*Tyto alba*) which is comparatively uncommon though widespread throughout the Punjab and Sind.

### RATTUS RATTOIDES

*Rattus rattoides* Hodgson, 1845; Turkestan Rat (see Illustration 76).

Synonym *Rattus turkestanicus* Satunin, 1903


**Taxonomy:** According to Schlitter and Thonglongya the name *rattoides* had earlier been applied to a new form of *Rattus* from Brazil in 1844 and therefore under the rules of nomenclature *Mus turkestanicus* as described by Satunin in 1903 should stand as the name for this species. (Schlitter and Thonglongya, 1971).


**Description:** A typical rat in appearance, it is mainly differentiated from *Rattus rattus* in the body, being invariably more grey coloured and the tail being conspicuously bi-coloured. The tail is generally longer than the head and body and its ventral surface is pale pinkish-grey with the dorsal surface much darker grey. The dorsal fur is always rather greyish in colour, sometimes quite slaty and the belly is invariably pure creamy white. It never shows the variations of *R. rattus* with rufescent tones in the dorsal fur or dark slaty colours in the ventrum.

Adult specimens vary from 95 to 170g ( $3\frac{1}{4}$ –6oz) in body weight. Dimensions of eight specimens from Gilgit and the Murree Hills are as follows: the head and body length averages 172mm (range 161–190mm), the tail averages 210mm (range 185–223mm), the hind foot averages 34mm (range 32–35mm) and the ear averages 24mm (range 22–25mm).

**Distribution and Status:** This rat seems well able to survive away from villages and human habitations and can adapt to coniferous forest as well as barren rocky mountain sides and mountain steppe regions. At times it behaves as a



*Rattus turkestanicus*  synonym *Rattus rattoides*

*Rattus norvegicus* 

Distribution Map 95 Turkestan Rat.  
Brown Rat or Norway Rat.



Illustration 76 *Rattus turkestanicus*: Turkestan Rat. (Based on fresh killed adult male specimen from Dunga Gali, Murree Hills.)

commensal of man, on other occasions as a purely field rat, living on the edges of mountain terraced cultivation. In fact it seems to have a seasonal migration pattern, preferring to live during the summer months on open hillsides away from human habitation and returning to villages in the winter.

The Turkestan Rat is the common House Rat in the Murree Hills, Chitral, Dir, Swat Kohistan, Gilgit and Baltistan. It has been trapped during the summer in Gilgit at Phandar, living on bare stony hillsides at 3100m (10,000ft) elevation and quite far from human habitation. In early spring I have trapped it at 2300m (7500ft) elevation, in Himalayan moist temperate forest at approximately 2.4km (1½ miles) from the nearest human settlement. It has been trapped at 6000ft near Kululai, Swat Kohistan, in a region of scattered deodar forest. *Rattus turkestanicus* does not occur in the plains nor apparently in Baluchistan. Some specimens of *Rattus* collected from the Punjab Salt Range by the Bombay Natural History Society Mammal Survey have been assigned to this species but it is not known whether a more recent critical review of the species would confirm this seemingly unusual southern distribution.

Outside of Pakistan, *Rattus turkestanicus* is widespread in the higher mountainous regions of Afghanistan, Russian Turkestan and Chinese Turkestan. It has not been recorded in Iran. Though it is much more restricted in distribution than *Rattus rattus* it does cause considerable damage to stored food grains, as well as to maize crops in the hills and mountain villages.

**Biology:** Much the same as the Roof Rat. This is an omnivorous, resourceful, and bold rodent which displays considerable intelligence. Two examples from my own observations may be cited. During our first holiday in Pakistan taken many years ago in late September at a small unfashionable hill station in the Murree Hills, my wife and I became the only remaining visitors. *R. turkestanicus* invaded our house in considerable numbers after the surrounding maize fields had been harvested. They became increasingly bold at night in plundering our food. A basket of walnuts proved difficult to carry far by mouth but these resourceful rats managed to leap with them up to the roof and then to roll each nut down

the sloping upper surface of a roof beam until the nut reached the outer wall and a suitable hideout. This very noisy and rather lengthy operation continued for two whole nights before we discovered the cause and removed the nuts. On one evening, hearing a noise in the pantry, we arrived in time to see a large flat piece of chapatti (unleavened wheat bread) actually rolled into a neat cylinder by a rat so that it could be dragged through a hole in the wall in front of our eyes. These same rats were also observed to eat soap.

Like *Rattus rattus* the species is very fecund. Female specimens from the Murree Hills have been collected bearing 4–6 foetuses and it seems possible that litter sizes are slightly smaller in this hill species, especially during the harsh winter months. As with other *Rattus* species the female makes a nest concealed in some crevice in a stone wall or a burrow which is often made from animal hairs, paper, jute, string and other rubbish and she rears her litters in this nest.

The Rock-horned Owl (*Bubo bubo*) and the Stone Marten (*Martes foina*) are both likely predators in Gilgit region, whilst *Felis bengalensis* and *Martes flavigula* may be more serious predators in the moister forested zones.

## RATTUS NITIDUS

*Rattus nitidus* Hodgson, 1845; Himalayan Rat.

This rat has been included by the Zoological Survey of Pakistan in the *Checklist of Pakistan Mammals* (Siddiqi, 1969). This is on the basis of specimens in the British Museum collection labelled 'Murree'. It is also included in Z. B. Mirza's book *The Small Mammals of West Pakistan* (1970).

Separation of *Rattus rattus* and *Rattus nitidus* is difficult and it seems likely that the few specimens in the British Museum labelled *R. nitidus* have been wrongly assigned, since the main distribution of this species is in South East Asia stretching from Indo-China to about Kumaon in the extreme west of its range and it is characteristically associated with tropical montane rain-forest, which biotope does not occur in Pakistan.



**Description:** Like *Rattus rattus* this species has a uniform darkly coloured tail which is longer than the head and body. The dorsal pelage is dark grey-brown and the belly fur varies from creamy-white to ochraceous buff. It has a longer muzzle than *Rattus turkestanicus*. A specimen in the British Museum from Murree and labelled as *R. nitidus* had the head and body length 164mm (6 $\frac{3}{8}$ in.), tail length 176mm (6 $\frac{7}{8}$ in.), hind foot 30mm (1 $\frac{3}{16}$ in.) and ear 26mm (1in.). There is only one specimen in the Bombay Natural History Society collection from Pakistan territory assigned to this species and it seems reasonable to presume that these few specimens are *Rattus rattus* and that *Rattus nitidus* does not extend its range west of Kumaon. It is significant that the correct identification of the British Museum specimens from the Murree Hills is also questioned by J. R. Ellerman (1961).

### RATTUS NORVEGICUS

*Rattus norvegicus* Berkenhout, 1769; Norway Rat, Brown Rat or Sewer Rat.

**Description:** This is normally a much larger rat than the Roof Rat, with a relatively shorter tail and deeper blunter muzzle. It is not always easy to identify individual specimens from tail length and the population of this rat inhabiting Karachi has a comparatively longer tail, sometimes equal to the head and body length. However in contrast to *R. rattus* it has much broader heavier incisors, greater body size and pale ventral surface to the tail, differences which are useful indicators. The ears of this rodent are comparatively smaller than is the case with the other *Rattus* species found in Pakistan and generally the naked scaly tail is comparatively thicker. Three specimens from Karachi average 229mm (range 222–255mm) (9in.) head and body length with tail averaging 196mm (7 $\frac{5}{8}$ in.) (range 190–220mm), and the hind foot 44mm (1 $\frac{3}{4}$ in.). The ear averages 16mm ( $\frac{5}{8}$ in.). Large males have been trapped weighing as much as 400g (14oz). Generally the dorsal pelage is dark greyish-brown and the belly uniformly grey and never as white as in *R. rattus*.

**Distribution and Status:** This is the most efficient burrower amongst the *Rattus* species inhabiting Pakistan. It excavates extensive tunnels under the foundations of buildings. It will also occupy drains and underground sewers. It is exclusively a commensal species in Pakistan, found only in towns.

This species is almost certainly not indigenous to the region and has probably been introduced accidentally by man since it is mainly confined to Karachi city and Pasni on the Mekran coast and has not succeeded in colonizing smaller towns and villages in the interior. It is the predominant species in Karachi, particularly in the port and dock area. There is some evidence that it has been introduced into Lahore city probably via grain shipments. But there are no definite records of its occurrence anywhere else in Pakistan (see Map 95). It is noteworthy that in the main cities on the eastern tropical sea coast of the subcontinent, such as Dacca, Chittagong and Calcutta, that *B. bengalensis* has become the successful commensal rodent and has largely replaced *Rattus norvegicus* though in Karachi *Bandicota bengalensis* has not succeeded in adapting to a commensal habitat.

*Rattus norvegicus* is a serious pest in Karachi, particularly in destroying rice and wheat stocks being stored at the TPX produce yards.

**Biology:** Similar to the other *Rattus* species but the Brown Rat is more aggressive and a bolder rodent. It is not quite so agile as *R. rattus* though it can climb well. They are probably more fecund than the Roof Rat with litters of 9–10 being commonly recorded. Like their congeners they are omnivorous, largely nocturnal in feeding activity, bold and inquisitive. One study of this species in the wild in Europe revealed that individuals within a certain territory recognize each other by smell and live in loose association which might be likened to a tribe. It was found that if any strange rat wandered into this tribal territory or was artificially introduced, then the other rats at once differentiated it by its smell and ruthlessly attacked and killed it.

### Genus MUS Linnaeus, 1758

Comprising about 15 species this genus includes the familiar House Mouse and embraces species which are largely confined to the subtropical regions of the Old World and Africa.

As indicated above the genus *Mus* is hardly differentiated from *Rattus* but because of the huge number of species involved, this subdivision is helpful. In the genus *Mus* the arrangement of the grinding teeth in the upper jaw is slightly different from *Rattus*. The first molar is always greatly enlarged covering as much as half the total tooth row length. At the same time the third molar is much reduced in size. By contrast the molars in the upper cheek tooth row of the genus *Rattus* are roughly equal in size with the third molar not being noticeably smaller than the first. Another helpful distinguishing feature is in the relatively short length of the outer (first and fifth) toes on the hind foot in members of the genus *Mus*. In *Rattus* though, the inner three toes are slightly longer, the first and fifth toes are not so markedly short on the hind foot. The layman generally considers mice and rats easily separable on the basis of size but some tropical species of *Rattus*, such as *R. exulans* found in Malaysia may often be no larger than *M. platythrix*.

### Key to the Genus MUS

Small rodents with head and body length generally under 80mm. Body fur sometimes hispid. Tail variable in length but rarely much over head and body length. Upper tooth row with M1 enlarged so that it is normally more than half the length of the tooth row. M3 very reduced in size. Upper incisors usually bearing a distinct notch or step in the posterior surface near the tip.

... *Mus*

### Key to the Pakistan Species of MUS

Four species have been recorded from Pakistan.

(i) Large size. Head and body length 90–110mm. Tail usually less than 90 per cent of head and body length. Hind foot 14–18mm. Inner surface of upper incisors not markedly notched at tip. Fur on dorsal surface and particularly lower flanks hispid or spiny. Habitat preference, stony or gravelly soils.

... *Mus platythrix*

(ii) Medium size. Head and body length 65–80mm. Hind foot 16–18mm. Tail generally just exceeding head and body length and not noticeably paler on ventral surface. Belly fur greyish-white. No spines in dorsal fur. Usually commensal in habitat preferences.

... *Mus musculus*

(iii) Medium size with head and body generally exceeding 70mm and tail less than head and body length. Ventral fur always creamy-white and dorsal fur pale sandy-grey. Hind foot 14–15mm. Usually favouring crop land and never commensal.

... *Mus cervicolor*

(iv) Small size with head and body length 55–75mm and tail at least equal to head and body length, often slightly longer. Hind foot 13–15mm. Belly fur pure white. Habitat preference crop land and scrub desert, well away from human habitation.

... *Mus booduga*

The taxonomy of the genus is difficult and recent studies by Dr. M. A. Beg (unpublished) in Lyallpur indicate that specimens from the Punjab formerly identified as *M. cervicolor* should be assigned to *Mus fulvidiventris* (Blyth, 1852), a distinct species.

## MUS MUSCULUS

*Mus musculus* Linnaeus, 1758; House Mouse.

Subspecies *Mus musculus bactrianus* Blyth, 1846; Persian House Mouse.

**Description:** The House Mouse is a relatively small, and very agile rodent with conspicuous rounded semi-naked ears and slender semi-naked tail generally equal to or longer than the head and body length. The muzzle is relatively sharp pointed, the eyes not conspicuously large and the pollex or thumb is generally opposable, which enables these little animals to climb up slender twigs.

In the Pakistan population of this mouse the tail is generally longer than the head and body length and is uniformly dark pink-grey in colour, an important feature which serves to distinguish it from the genus *Apodemus*. The upper parts of the body are dark greyish-brown with the fur relatively dense and soft. Sometimes there is a yellowish-fawn tinge to the flanks and they are generally paler in colour than west European forms. The belly fur tends to be greyish-white, varying to pure white. The subspecies *M. m. bactrianus* is differentiated on the basis of its paler dorsal colouration.

Sixteen specimens in the British Museum collection from Baluchistan, Sind and the Punjab had the head and body averaging 74mm (range 60–83mm) with the tail averaging 76mm (range 62–89mm), the hind foot averaging 16mm ( $\frac{5}{8}$ in.) (range 14–18mm), and the ear 13mm ( $\frac{1}{2}$ in.) (range 11–15mm). Two typical specimens from Karachi weighed 12g ( $\frac{1}{2}$ oz). In his key to the genus *Mus*, J. R. Ellerman (1961) states that the skull length (occipito-nasal) is generally below 23mm ( $\frac{7}{8}$ in.).

If the upper incisors are examined critically their inner surface will be found to bear a notch or step near the tip (see Fig. 69). This notch is not found in the upper incisors of *Apodemus sylvaticus*. Nor is there any noticeable notch in the upper incisors of *Mus platythrix*.

Females generally have five or six pairs of mammae.

**Distribution and Status:** This mouse is commonly found frequenting cracks and crevices under walls of buildings in villages and cities alike. It will however live in crop land for certain seasons or possibly indefinitely. They have been trapped throughout Pakistan including the mountainous areas, in which latter regions they are generally in association with human habitations. In Baluchistan however I have trapped it



*Mus musculus* Known distribution  
Probable range

Distribution Map 96 House Mouse.

at 6000ft elevation in a barren stony ravine four miles from the nearest human habitation.

It occurs throughout the Indus plains and in Baluchistan, even in remote mountain villages. In the north it extends into the mountain valleys of Hazara District, Chitral and Swat. It has been collected at such widely scattered localities as Pasni on the Mekran coast and in Naltar north of Gilgit, as well as Naran in the Kaghan Valley, both the last two villages being over 2150m (7000ft) above sea-level.

In studies of villages in Lyallpur area (Taber et al., 1967) it was found that houses inhabited by *Rattus rattus* precluded the presence of *Mus musculus* but that in city areas the two species could be trapped in the same vicinity. It was presumed that in an ecologically simple type of house, the larger and more aggressive rat drove out the House Mouse. Interspecific competition is probably not so severe in cities where the close proximity of numerous houses affords many more places of refuge for the smaller species.

The House Mouse is well able to exist for limited periods away from human habitation but judging from the localities where it has been trapped it is inclined to be commensal wherever it is found in Pakistan and specimens trapped in crop land are probably evidence of local seasonal movements only.

**Biology:** The House Mouse is largely nocturnal in activity and omnivorous in feeding habits. They are not particularly gregarious but certainly more than one individual will utilize the same burrow system. Whilst the forms which inhabit crop land probably feed mainly on seeds and vegetable matter they will eat insects and all kinds of human food such as cooked rice, meat, soap and leather. They have been recorded as feeding on human faeces in villages, and they are vectors of harmful diseases such as scrub typhus. Because of their smaller size they do not cause such widespread damage to food grains as, for example, *Rattus rattus*, but they may occasionally carry seeds and fruit into their underground burrows for storage and they certainly damage and destroy more food than they actually consume.



They are very prolific and the females reach sexual maturity at about 12 weeks of age. With a gestation period which has been recorded as varying from 18 to 21 days, they are capable of producing litters in every month of the year. Specimens of *M. m. bactrianus* have been collected bearing 3–6 foetuses and five seems to be about the average. *Mus musculus* in captivity has produced litters of up to 12 but this is probably above normal for the wild population in Pakistan. The young which are blind and naked at birth are sheltered in an underground nest often constructed from bits of household rubbish. The female particularly favours chewed paper and old bits of rag for such nest building. Ten days after birth the young have their bodies well covered with fur but their eyes generally do not open until about the fourteenth day and within one week of this time they are weaned and leave the nest. The House Mouse, particularly sub-adult individuals, is so plentiful and widespread that it provides the main food for the Spotted Owl (*Athene brama*) and Mongooses (*Herpestes* spp.). There are also records of it being attacked and eaten by Hedgehogs (*Hemiechinus* spp.) and Musk Shrews (*Suncus* spp.).

Captive specimens from domesticated strains have lived up to six years but it is unlikely that wild specimens live for more than two years.

In Pakistan *Mus musculus* is certainly well able to survive in very arid regions, and apparently never needs to drink free water.

MUS BOODUGA

*Mus booduga* Gray, 1837; Little Indian Field Mouse (see Illustration 77).  
 Synonym *Leggada booduga*

**Description:** Similar to the House Mouse but averaging considerably smaller in size with the lower limbs and belly

always pure white and the dorsal fur usually rather pale greyish-buff coloured. The tail length varies but is usually equal to head and body length or slightly more. It is not noticeably bi-coloured. It has a sharply pointed muzzle and prominent rounded ears. Three specimens from the Punjab and two from Sind had the head and body averaging 62mm (range 56–63mm) with the tail averaging 63mm (range 55–75mm) ( $2\frac{1}{8}$ – $2\frac{1}{2}$  $\frac{5}{16}$ ) long. The hind foot averaged 14mm (range 14–16mm) with the ear averaging 11mm ( $\frac{7}{16}$ in.) (range 11–13mm). In his key to the genus *Mus* for the Indo-Pakistan subcontinent J. R. Ellerman (1961) states that the occipito-nasal length is generally below 20mm ( $\frac{13}{16}$ in.), and that the space between the upper incisors and the first molars (the diastema) is usually more than one-quarter of the total skull (occipito-nasal) length, whereas the diastema in the House Mouse is generally just under one-quarter of the occipito-nasal length. Adults may weigh as little as 10–15g ( $\frac{1}{3}$ – $\frac{1}{2}$ oz).

**Distribution and Status:** The Little Indian Field Mouse inhabits cropland or patches of tropical thorn scrub on the edges of cultivation and does not show any commensal tendencies though it may be trapped in gardens in the close vicinity of houses. It often occurs in sandhill tracts which are uncultivated at a considerable distance from any human habitation. It appears to avoid mountainous areas.

The Little Indian Field Mouse does not appear to have penetrated the Baluchistan hills or the Himalayas. It probably does not invade extensive sand-dune desert tracts though I have trapped it from the burrows of *Gerbillus gleadowi* on the edge of the Cholistan Desert much further from the nearest cultivated tracts than the normal range of this Field Mouse. It is believed that they occupy and live in a territory which is probably less than 20 or 30m (66–99ft). square. It has also been trapped at 610m (2000ft) elevation in the Margalla hills on rocky hillsides but there is no evidence that it ascends very high into mountainous areas and there

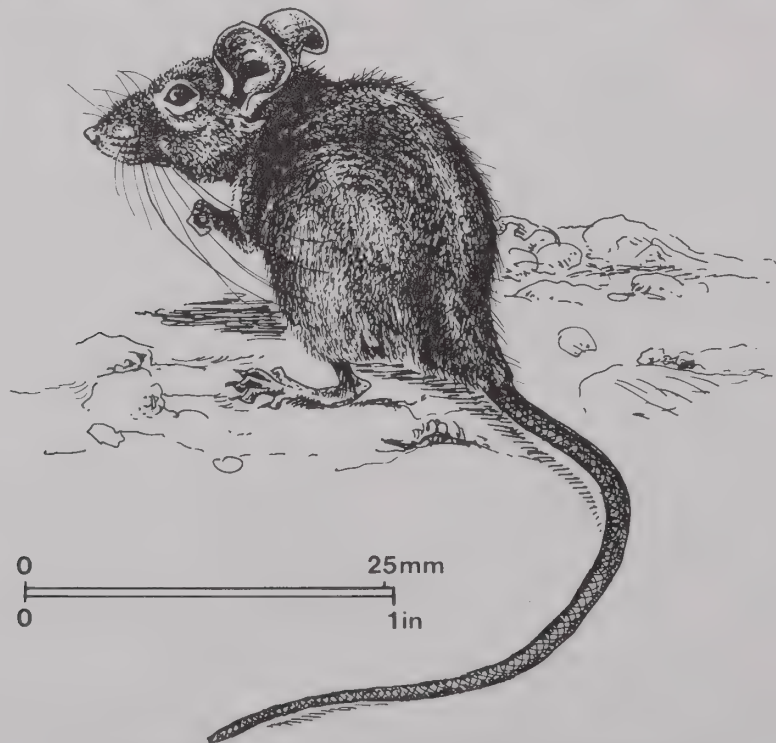


Illustration 77 *Mus booduga*: Little Indian Field Mouse.  
 (Based on captive specimen collected in October from  
 Khanewal, Punjab.)



Mus booduga

Distribution Map 97 Little Indian Field Mouse.

are no definite records from either the North West Frontier Province or the Himalayas.

Elsewhere it extends throughout India but has not so far been recorded in Iran or Afghanistan.

Though it is widespread and does do some damage in crops, due to its small size and non-colonial habits, it does not appear to be a serious economic pest.

**Biology:** Nothing has been specifically recorded about this mouse to indicate that its habits are markedly different from *Mus musculus*. It is nocturnal and not markedly gregarious and shelters in underground burrows during the day. It appears to feed on vegetable matter and seeds but no doubt will eat insects and any fallen fruit that is available.

They are very agile and can climb well. Sometimes they do considerable damage in crops of sweet potatoes or melons, gnawing holes in the fruit or tubers. Due to their small size such damage is never very extensive. They appear to be able to breed throughout the year and to produce litters varying from four to eight.

## MUS CERVICOLOR

*Mus cervicolor* Hodgson, 1845; Fawn-coloured Mouse.

**Taxonomy:** The Punjab population of this species may be a distinct species, *Mus fulvidiventr* (Blyth, 1852), according to recent researches by Dr. Mirza A. Beg (unpublished).

**Description:** This mouse appears to be similar to *Mus booduga* with no very distinctive colouration of the body fur, despite its scientific name. Specimens examined by me in the Bombay Natural History Society and British Museum collections assigned to this species have the same greyish-fawn dorsal fur as *M. booduga*. It is however larger in size than *M. booduga*, specimens averaging the same size as *M. musculus*. The tail sometimes has a slightly paler ventral surface. The belly fur is always pure white as in *Mus booduga* and the dorsal fur is soft without showing any hispid tendencies.

In the *Fauna of India*, J. R. Ellerman (1961) gives the maximum occipito-nasal length for *M. cervicolor* as 23mm ( $\frac{7}{8}$  in.). Three specimens from Pakistan in the Bombay Natural History Society collection had the head and body averaging 76mm (3 in.) (range 70–79mm) with the tail averaging 64mm ( $2\frac{9}{16}$  in.) (range 59–74mm), the hind foot averaging 14mm ( $\frac{5}{8}$  in.) (range 13.5–16mm), and the ear averaging 12mm ( $\frac{7}{16}$  in.) (range 11–14mm).

**Distribution and Status:** This appears to be the same as for *M. booduga*. It is a Field Mouse which shuns human habitation and is equally at home in crop land or scrub desert uncultivated regions. They do not occur in mountainous areas.

The Fawn-coloured Mouse is not included amongst the *Checklist of Mammals of Pakistan* published by the Zoological Survey (Siddiqi, 1969). This is probably because it is only represented in the British Museum collection by specimens from Peninsular India. Dr. R. D. Taber collected specimens in relict patches of tropical thorn scrub in Lyallpur District which were assigned to this species by the British Museum (Taber et al., 1967). There is one specimen in the Bombay Natural History Society collection from the Salt Range in the Punjab. I have trapped specimens from Pumpkin crops in Sanghar District in north eastern Sind which correspond to the key given by J. R. Ellerman (1961) for the Fawn-coloured Mouse. According to Ellerman and Morrison-Scott (1951) it occurs mainly in southern India and Ceylon extending northwards to Gujrat and Rajputana. It also appears to turn up again in Nepal, Assam, and Burma. It is not well represented in any museum collections, but if it is a distinct species it would appear to occupy more or less the same habitat as *M. booduga* extending throughout the Indus plain in Pakistan.

In the light of our present knowledge *M. cervicolor* seems ecologically sympatric to *M. booduga* and there may not be strong grounds for considering it as a distinct species merely on the basis of a slightly larger size. There is no evidence that they do not interbreed in the wild as I have trapped Field Mice in Sind from the same biotope, some of which could



Mus cervicolor Known distribution Possible range

Distribution Map 98 Fawn-coloured Mouse.



be assigned to *M. cervicolor* and others to *M. booduga* according to J. R. Ellerman's key. It remains for further field investigations to clarify the exact status of the Fawn-coloured Mouse.

**Biology:** The same as for *M. booduga*.

### MUS PLATYTHRIX

*Mus platythrix* Bennett, 1832; Indian Brown Spiny Mouse.  
Synonym *Leggada platythrix*

**Taxonomy:** The Pakistan population of this mouse was assigned to a separate subspecies *Mus platythrix sadhu* on the basis of its paler grey dorsal fur. According to Dr. J. Marshall, an authority on the Genus *Mus*, the population of *M. platythrix* inhabiting Pakistan should be assigned to a separate species, *Mus saxicola*.

**Description:** The distinctive characteristic of this mouse is in the peculiar bristle-like hairs in the dorsal region. The degree to which the fur becomes hispid varies markedly and is only really apparent in the region of the pelvis and can be detected by stroking the fur backwards with the finger. In a few individuals the hairs in this region are visibly flattened and broad towards their base, but this is difficult to detect without a magnifying glass. It is also rather a large mouse averaging considerably greater in head and body length than *M. musculus*. Average dimensions of 13 specimens from southern Sind, are head and body length 82mm (range 72–98mm) ( $2\frac{7}{8}$ – $3\frac{7}{8}$  in.) with the tail averaging 70mm (range 56–79mm) ( $2\frac{3}{16}$ – $3\frac{1}{8}$  in.) in length and the hind foot averaging 17mm (range 16–18mm) ( $\frac{5}{8}$ – $\frac{11}{16}$  in.) and the ear averaging 14mm (range 13–16mm) ( $\frac{1}{2}$ – $\frac{5}{8}$  in.). Generally this mouse is a paler more sandy-grey colour than the House Mouse.

Some individuals exhibit warmer brown-grey tones in the dorsal regions. The belly fur is pale creamy white and the tail usually is slightly paler on its ventral surface, which field characteristic helps to distinguish it from the House Mouse. The tail is comparatively short in this species, generally being 90 per cent of the head and body length and this feature also serves to distinguish it from *Mus musculus* in Sind region. Another important distinguishing feature is the absence of any conspicuous notch on the inner surface near the tip of the upper incisors which serves to distinguish *Mus musculus*. In the *Fauna of India*, J. R. Ellerman's (1961) key for the Indian Spiny Mouse indicates that the occipito-nasal length generally exceeds 23mm ( $\frac{7}{8}$  in.).

Females usually have four pairs of mammae, which is a lesser number than the House Mouse. These mammae are also situated high up in the pectoral region and because of this characteristic the Spiny Mouse was at one time put in a distinct genus (Thomas, *JBNHS*, 1920B).

**Distribution and Status:** The Spiny Mouse seems to be restricted to the dryer and more hilly uncultivated tracts, when compared with the Small Indian Field Mouse or the Fawn-coloured Mouse. It is never found commensally or in association with human dwellings and does not seem to favour irrigated cropland preferring rather arid waste tracts.

The Spiny Mouse is only common in southern Sind through Thatta and Tharparkar districts, and mainly in limestone hill regions. It extends westwards to the Hub river valley but there are no definite records for Baluchistan. There is a specimen in the British Museum labelled Lahore District but I have not come across any *Mus* species showing a hispid



*Mus platythrix* Known distribution  
Probable range

Distribution Map 99 Indian Brown Spiny Mouse.

fur characteristic trapped from the Punjab and the Punjab University has a sizeable collection of *Mus musculus* and *Mus booduga* specimens.

Elsewhere it extends through the dryer part of north west India from Kathiawar and Kutch south to Travancore.

**Biology:** Very little has been recorded about this mouse except for its peculiar habit of collecting small stones and pebbles which it takes into its burrow for lining its nest chamber. These burrows are often excavated in bare open ground away from any protective vegetative covering. Sometimes this mouse will seal the entrance of its burrow, when in occupation, using small stones.

They are typical of other members of the genus in being nocturnal, not markedly gregarious, largely omnivorous in diet, and very active and agile.

No specific information is available regarding their breeding biology but they are presumed to be capable of producing litters throughout the year, in the relatively warm southern latitudes where they occur in Pakistan.

They are evidently able to survive without any free water to drink and may be able to undergo short periods of inactivity or torpor during periods of intense heat and food scarcity.

### Genus GOLUNDA Gray, 1837

This is a monotypic genus represented by a species which is confined to the Indo-Pakistan subcontinent. Because of the peculiar columnar structure of the grinding teeth it is placed in a separate genus and is believed to be more primitive phylogenetically than the other closely related *Muridae* of the Genus *Rattus*.

### Key to the Genus and Pakistan Species of GOLUNDA

Dental formula: incisors, 1/1; canines 0/0; pre-molars, 0/0; molars, 3/3.

Medium sized. Head and body length 115–155mm. Tail

about 80 per cent of head and body length and rather more hairy than in true rats and mice. Ear circular and well covered with hairs. Sole of hind foot blackish. Incisors reddish and prominently grooved. Cheek teeth strongly cuspidate with three rows of columnar cusps.

... *Golunda ellioti*

### GOLUNDA ELLIOTI

*Golunda ellioti* Gray, 1837; The Indian Bush Rat or *Golunda* (see Illustration 78).

**Description:** Ratlike in form and general colouration it could be mistaken in the field for *Rattus rattus*. Close examination, however, reveals the following rather distinctive characteristics. Its size is considerably smaller than *Rattus rattus* and the tail is generally slightly shorter than the head and body length, and though showing annulations and a semi-naked scaly appearance, is much better covered with short hairs than in *Rattus* species. It is also noticeably bi-coloured being dark brownish on the dorsal surface and yellowish-grey on the ventral surface. Its prominent black eyes are relatively bigger than in *Rattus* species and the ear is almost circular in outline being well covered both inside and outside of the pinna with short buff hairs (see Fig. 70). *Rattus rattus* by contrast has semi-naked ears with the tail longer than its head and body. The head is also more bluntly rounded and vole-like in appearance. The body fur is of a dark yellowish-brown varying to greyish-brown, but on close examination will be found to consist of intermixed black-tipped and reddish-fawn hairs giving the pelage a speckled effect. The belly fur is slaty, with paler tips to the hairs.

This Bush Rat has stout well-developed feet with four digits on the fore-feet and a very short vestigial thumb, bearing a claw. The hind sole is naked on its under surface with five digits, the outer toes being much shorter than the central ones (see Fig. 70). The soles of the hind feet are always blackish or dusky-grey whereas the soles of other *Muridae*, if not covered by hair, are invariably pink or brownish-pink, and this seems to be the most reliable diagnostic feature.

When examined in the hand, the incisors are broad and strongly developed, being coated with reddish-orange enamel and bearing a very conspicuous longitudinal groove on the outer surface of the upper incisors. As indicated above the grinding teeth are very distinctive in this species, their surfaces are cuspidate with the molars having a columnar appearance (see Fig. 71).

Four specimens from Malir in Sind, varied in weight from 50 to 80g ( $1\frac{3}{4}$ – $2\frac{7}{8}$  oz). Average dimensions of 27 specimens from Sind and the Punjab are as follows. Head and body length average 126mm (range 114–155mm) with the tail averaging 109mm (range 93–125mm) in length and hind feet averaging 26mm (range 24–28mm) and the ear averaging 18mm (range 15–19mm). Females have eight mammae.

**Distribution and Status:** This Bush Rat, endemic to the Indian subcontinent, is not highly adapted to arid regions and has only succeeded in colonizing Pakistan in the extreme southern coastal region of Sind as well as in the extreme north eastern part of the Punjab adjacent to the Himalayan foothills. It shows, therefore, the typical distribution pattern of those oriental faunal zone species which prefer mesic conditions. In Pakistan it is found in relatively barren regions provided there is some growth of tropical thorn scrub or grass clumps and it seems to favour rocky tracts rather than cultivated valley bottoms. It is not found in extensive regions of alluvial deposits such as characterize the Indus plain, except where there are relict areas of the original tropical thorn forest and it evidently avoids saline areas.

It has been collected from Las Belas in the Hub River valley and in the southern part of Sind, particularly on the west bank of the Indus from Landhi as far north as Larkana. It has also been collected at Naundero in Thatta District and at Gambat in Khairpur. It has thus been able to spread up the Indus valley in the riverine zone. Apparently absent from Bahawalpur Division and the southern Punjab it has been trapped at Changa Manga forest, 48km (30 miles) south west of Lahore. It also occurs in the Salt Range and spreads across the Indus as far as Kohat in the North West Frontier Province.



Illustration 78 *Golunda ellioti*: Bush Rat. (Based on captive specimens from Malir, Sind and Margalla Hills near Islamabad.)



It occurs around Rawalpindi and is quite plentiful in the Margalla Hills.

Altogether it is of restricted occurrence in Pakistan and nowhere very plentiful. It does occur around the edge of crops in Landhi area and may cause a small amount of damage, but it is generally associated with uncultivated regions and does not appear to be of any economic importance, though it is noteworthy that in the early days of coffee plantations in Ceylon it became a serious pest, eating the coffee berries as well as buds and blossoms (Sterndale, 1884).

Extra-limitally its distribution is confined to India where it is somewhat irregular. It is mainly found in the Deccan, the Nilgiris and Ceylon. It occurs in Rajputana and Kathiawar and also in the east Punjab (India) including the Kangra Valley. It has not been recorded west of the Hub River valley and is unknown in Iran and Afghanistan.



Fig. 70 Showing comparison of rodents' ears and feet. Right ear pinna of:

1. *Apodemus sylvaticus*.
2. *Calomyscus bailwardi*.
3. *Golunda ellioti*.
4. *Hyperacrius wynnei*.

Note hairy appearance of *G. ellioti*. Ear of *H. wynnei* is normally concealed by body fur. These ear drawings are not to the same scale.

5. Sole of right hind foot *Apodemus sylvaticus*.
6. Same, left hind foot *Calomyscus bailwardi*.
7. Same, right hind foot *Golunda ellioti*.
8. Upper view right fore-foot *Hyperacrius wynnei*. Note fossorially adapted elongated claws with powerfully muscular forearm.

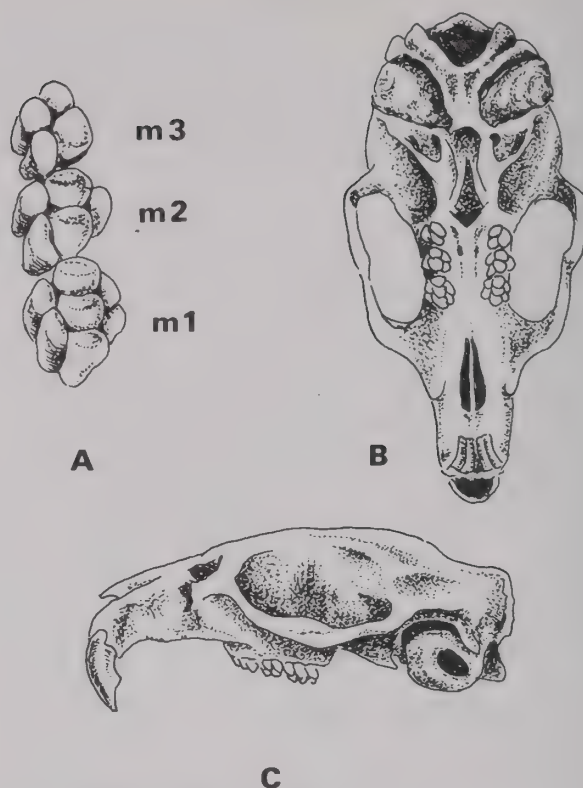


Fig. 71 Showing features of Bush Rat.

- A. Detail of right upper (maxillary) tooth row of *Golunda ellioti*. M1 represents the anterior or first molar.
- B. Ventral view of skull.
- C. Lateral view of skull.

**Biology:** This rat is not particularly gregarious and since it is not a very active burrower, preferring to shelter amongst rock crevices, its presence is sometimes difficult to detect. They appear to be gentle in disposition and several individuals will share the same burrow system but their burrows do not occur in large colonies. In Landhi I have found them occupying burrows along the base of an euphorbia hedge but these may have been excavated by gerbils. I have also found them occupying burrows around the base of a prickly-pear hedge (*Opuntia dillenii*) in the Salt Range and these burrows were also shared by Soft Furred Field Rats *Millardia*, which may have been excavated by the latter species. They make regular runways through grass and use available cover under bushes and around overhanging rocks.

Earlier writers have noted that this Bush Rat is quite diurnal in its feeding activity (Sterndale, 1884 and Finn, 1929). Observations in Malir indicate that they are mainly nocturnal in the more populated areas, emerging to forage just at dusk. However in regions of better vegetative cover and less human disturbance they can be active at any time of the day and I have frequently watched them actively feeding in the Margalla Hills in the middle of the day or mid morning, both during late January and late April. On cold or wintry nights they often do not emerge above ground at all to forage.

With their naked soles they are adept at climbing in trees and low bushes and their diet consists of a mixture of seeds, berries, young shoots as well as grass stems and all kinds of succulent vegetable matter. Captive specimens drank water when offered but were able to subsist indefinitely without



*Golunda ellioti*    Known distribution  
Probable range

Distribution Map 100    Bush Rat or Golunda.

water as long as fresh green food was provided. In south India they feed largely on the seeds of the Lantana bush (Prater, 1965) and their peculiar cuspidate molars would make them well adapted to feeding on such hard seeds.

The Bush Rat is often referred to as being a rather sluggish animal (Walker et al., 1964 and Prater, 1965). Captive specimens can generally be handled without biting and show a relatively mild disposition. Several individuals readily shelter together in physical contact and display no sign of intra-specific aggression. However, captive specimens seemed quite agile and active and my observations do not indicate that they are in any way sluggish.

Little is known about their breeding biology but the young are probably reared in a specially-constructed nest of grass. In south India they construct these nests in low bushes. Captain Whitehead found such a nest near Kohat under a rock crevice. Litter sizes of three or four have been recorded and they are believed to breed mainly in the spring and summer months (Walker et al., 1964). A female trapped by J. A. W. Anderson in April gave birth to two young shortly afterwards on 23 April. Specimens captured by me in Landhi in January showed the males with testes very much regressed and no sexual activity was observed until April. Though mating was not actually observed a litter of four was born on 10 May. These were relatively quick growing like other Murine rodents. They were fully clothed with hairs on about the sixth or seventh day, and were able to crawl about on the fourteenth day.

Nothing is known about the longevity or gestation period of this species. They are apparently not highly prolific and breeding seems to be confined to the summer months.

#### Genus ACOMYS Geoffroy, 1838

This genus has been created to cover a small group of desert dwelling mice, whose body is covered with spiny bristles with very little underfur. Four or five specimens have been des-

cribed ranging from Egypt through the Middle East and southern Iran. The latest view seems to be that *Acomys dimidiatus* is conspecific with *A. cabirinus* and that there are probably only two distinct species (Setzer, 1959). The dentition in this genus is similar to *Rattus*.

#### Key to the Genus and Pakistan Species of ACOMYS

Dental formula: incisors, 1/1; canines, 0/0; pre-molars, 0/0; molars, 3/3.

Small rodents (70–120mm head and body length) with the whole of the dorsal pelage composed of stiff spines. Naked ears somewhat elongated. Scales on tail conspicuous and tail length generally sub-equal to head and body length.

Spines reddish tan colour, being darker in spinal area.

... *Acomys cabirinus*

#### ACOMYS CAHIRINUS

*Acomys cabirinus* Desmarest, 1819; Cairo Spiny Mouse (see Illustration 79).

Synonym *Acomys dimidiatus* Cretzschmar, 1826; The Spiny Mouse.

**Description:** Mouselike in form and general appearance it reveals the following distinctive characteristics upon closer examination. The tail is generally rather short and conspicuously scaly being sparsely covered with very short stiff bristles. The tail can be extremely variable in length in this species with considerable individual variation but generally it is slightly shorter than the head and body length. It seems to be curiously brittle, with a tendency to be partially lost in living specimens. The tail is generally bicoloured, being greyish-white ventrally and plumbeous dorsally. The muzzle is particularly long and pointed in this species and the eye is large and prominent with the vibrissae being long and whitish. The upper incisors of the Spiny Mouse are smooth without any longitudinal groove. They are rather slender and coated with pale yellow enamel. The ears are naked, greyish-black in colour and comparatively long and upstanding in this species. Often the ears have a rather wrinkled appearance, the conch being partly folded back. The feet are stout with rather short toes having four digits on the fore-foot and five on the hind feet. The naked soles are dark brown in colour and the plantar pads tend to be somewhat rugose.

The most striking feature about this mouse is the appearance and colour of the body fur. The lower part of the cheeks, throat and belly is covered with normal pure white fur, but the upper part of the body is yellowish-brown or biscuit colour and consists of stiff flattened hairs which are spine-like in shape. Usually the spines in the mid dorsal region are a darker blue-grey colour and they are also more hair-like, being thinner and softer in the region of the neck and shoulders but becoming stiffer and thicker around the flanks.

A captive specimen from Ormara revealed naked skin between the spines, there being no softer under-fur and this skin was pigmented blackish. In populations of this mouse from Egypt and Arabia there seem to be two colour morphs (D. L. Harrison, 1972). One with bristles of a bluish-grey colour all over the body, appears to be commensal in living habits. Only the gingery-buff form has been collected in Pakistan.

There are insufficient measurements of Pakistan specimens to indicate anything about the size of the local populations. There are only two specimens in existence



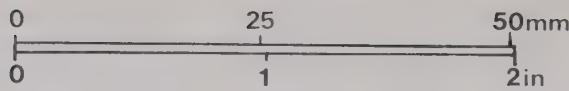


Illustration 79 *Acomys cabirinus*: Cairo Spiny Mouse.  
(Based on fresh killed specimen from Kirthar Hills, Sind and captive specimens in Regents Park Zoo of unknown origin.)

from Pakistan territory at present. The original (in spirit), which was collected in 1890, is in the British Museum Collection. Its head and body length is 90mm, tail 101mm, hind foot 19.5mm but its ear length is not recorded. A second specimen collected in 1973 is in the American Museum of Natural History in New York. Its head and body length is 115mm, tail length 106mm, hind foot 21mm, and ear 17mm. Specimens from Iran and the Persian Gulf average larger than any *Mus* species. British Museum specimens from southern Iran varied from 100–160mm ( $3\frac{7}{8}$ – $6\frac{5}{16}$  in.) head and body length. The tail varying from 77–160mm ( $3$ – $6\frac{5}{16}$  in.). The hind foot averaged 19mm ( $\frac{3}{4}$  in.) and the ear 20mm ( $\frac{25}{32}$  in.) in six specimens measured. The weight of adult specimens from North Africa and the Middle East is recorded as varying from 50 to 90g ( $1\frac{3}{4}$ – $3\frac{1}{4}$  oz) (Walker et al., 1964) but the Karchat specimen weighed only 40g. Females have four to six mammae.

**Distribution and Status:** Throughout its range it is associated with barren rocky regions, though its exact distribution in Pakistan is very imperfectly known. It does not seem to be associated with sand-dune regions, preferring dryer rocky mountain slopes and there is no evidence in the Pakistan population of commensal tendencies which are exhibited by the Egyptian population.

As indicated already, very little material has been collected. In the 1890s H. E. Watson collected an adult male in the Laki Hills of Dadu District in Sind (Thomas, 1917). In March 1973, Dr. Schaller collected the specimen described above from the Karchat Hills in the Kirthar range of Sind. During the Mammal Survey of Southern Baluchistan between 1916–1918 Colonel Hotson collected several specimens from Karochi Dak in the Mekran coastal region as well as at

Chahbar just west of the border of Baluchistan in Iran. In 1965 some Jogi trappers collected a specimen from near Ormara in the Mekran which was in the possession of J. A. W. Anderson in April and May of that year. These scattered records would seem to indicate that it has spread across the Mekran coastal hill ranges and when more collecting is pos-



*Acomys cabirinus* [shaded box] synonym *Acomys dimidiatus*  
[hatched box] Probable range  
Distribution Map 101 Cairo Spiny Mouse.

sible it will probably turn up in intervening areas such as Las Belas and the Pab range of hills.

Extra-limitally it occurs in Cyprus, Egypt, Saudi Arabia, the Sudan and Israel. It has not been recorded in Afghanistan. In Iran it has been collected from the south eastern province of Fars and also Kerman and it seems to be uncommon and of restricted distribution judging from the few records (Lay, 1967). It occurs nowhere east of the Indus River.

In the present state of our knowledge it must be considered rare and erratic in distribution in Pakistan.

**Biology:** It has not been studied in Pakistan but presumably its habits do not differ greatly from observations recorded elsewhere. The Spiny Mouse lives largely amongst natural rock crevice or it may occupy burrows excavated by other species. They are not particularly gregarious. They have been described as occupying burrows excavated by Gerbils (Walker et al., 1964). In Iran it was trapped on a rocky hill-side where *Calomyscus bailwardi* was also living in large numbers. Observation on specimens exhibited in Regents Park Zoo indicate that they are extremely agile, well able to jump amongst rocks and that they seem to be fairly social in behaviour.

They are partly diurnal and particularly active in the early morning and evening hours, and may enter villages and human habitations. This was confirmed by observations on wild specimens in the Karchat Hills which regularly entered Dr. Schaller's camp each evening (pers. comm.). The black pigmentation of the skin would be a valuable ecological adaptation in the absence of protective underfur for such a diurnally active rodent.

They are recorded as being largely graminivorous in diet in Saudi Arabia (Vesey-Fitzgerald, 1953). In Egypt they are recorded as being practically omnivorous, eating the same sort of food as *Mus musculus*, such as household refuse and insects when available (Walker et al., 1964).

The Spiny Mouse differs greatly from most *Muridae* in having an unusually long gestation period and comparatively small litter sizes. The gestation period is normally 36 days but up to 42 days have been recorded (Walker et al., 1964), and two or three is quite a normal litter size. The newly-born young are naked but are better developed than is the case with other *Muridae* as the eyes are often open at birth and they are large in size and are weaned at 14 days (Dieterlen, 1963). Male specimens in captivity were found capable of breeding when about seven weeks old. Breeding may be confined to the spring and early summer months, though Corbet (1966) records post-partum oestrus. This mouse seems to be much less prolific than members of the *Mus* Genus.

Nothing is known about the predators on this mouse but it favours the same kind of stony habitat where the Euphratic Viper (*Vipera lebetina*) and the Saw-scale Viper (*Echis carinatus*) are known to occur in Baluchistan, and it may fall prey to either of these snakes. It may also be hunted by raptors, being diurnal. When alarmed this mouse can erect its spines and make itself look larger (Vesey-Fitzgerald, 1953).

#### Genus BANDICOTA Gray, 1873

The Bandicoot Rats were originally assigned to two separate genera (*Bandicota* and *Gunomys*). Ellerman has pointed out that the basis for these separate genera rests upon inconsistent characteristics (Ellerman, 1961). There are two species extending throughout the oriental faunal zone in the warmer more tropical humid regions. They are not well adapted to semi-desert regions such as prevail in Pakistan. In external

appearance they closely resemble *Rattus*, but the main feature which distinguishes *Bandicota* from *Rattus* is the elongated palatal foramen which is at least 18 per cent of the total skull (occipito-nasal) length (see Fig. 72). The upper incisors are slightly prouodont so that the condylobasal length is greater than the occipito-nasal length (J. Harrison, 1966).

#### Key to Genus BANDICOTA

Dental formula: incisors, 1/1; canines, 0/0; pre-molars, 0/0; molars, 3/3.

Large rat-like rodents with powerfully developed incisors usually measuring more than 4mm across the tips. Tail uniformly coloured and more than 75 per cent of head and body length. Palatal foramina of skull elongated normally exceeding 7mm in length.

#### Key to the Pakistan Species of BANDICOTA

Ventrum dark grey and dorsal fur dark brown. Ears and tail naked and blackish-grey. Palatal foramen 8mm long. Twelve to 20 mammae, not in regular pairs.

... *Bandicota bengalensis*

#### BANDICOTA BENGALENSIS

*Bandicota bengalensis* Gray and Hardwicke, 1833; Lesser Bandicoot, Indian Mole Rat, also referred to as the Sind Rice Rat (see Illustration 80).

Synonym *Nesokia bengalensis* Murray, 1884; and *Gunomys indicus* Wroughton, 1908.

**Description:** The Lesser Bandicoot is superficially like the Brown Rat (*Rattus norvegicus*) in external appearance. It is a large, robustly built rat with a semi-naked scaly tail slightly shorter than the head and body length. The tail is sparsely covered with hairs and generally uniformly coloured blackish-brown. It shows prominent annulations and terminates in a more slender point than the tail of typical *R. norvegicus* specimens.

The body fur is rather coarse and feels harsh when compared with that of *Millardia* species. It is a dark olive-brown varying to reddish-brown in the dorsal region bearing scattered much longer black hairs which feature is shared by *B. indica* and gives this rodent a rather shaggy appearance. The belly fur is dark greyish. The naked pink ears are more rounded than in *R. norvegicus*. The eyes are black and protuberant and are relatively small when compared with *Millardia* or *Golunda* species. There are four digits on the fore-feet and five on the hind feet, the outer toes being shorter than the central three. The fifth or outer toe is always longer than the hallux or inner toe on the hind foot. Each digit bears strong claws, and the fore-feet are comparatively larger and well developed. The digits are pink and naked.

Examination of the skull, besides showing relatively elongated palatal foramina, reveals that the tympanic bullae are enlarged, being normally over one-fifth of the occipito-nasal length. The incisors are very broad and smooth on their anterior surface without any longitudinal groove. They are covered with bright orange enamel and are prouodont. This is a valuable ecological adaptation since this rodent is a most active and powerful digger as will be seen below. Specimens from Sind are generally a bit smaller than those from other parts of India with adults weighing up to 227g (8oz) whereas very large specimens from south India have been recorded





Illustration 80 *Bandicota bengalensis*: Lesser Bandicoot Rat or Indian Mole Rat. (Based on live specimen from Rawal Lake near Rawalpindi.)

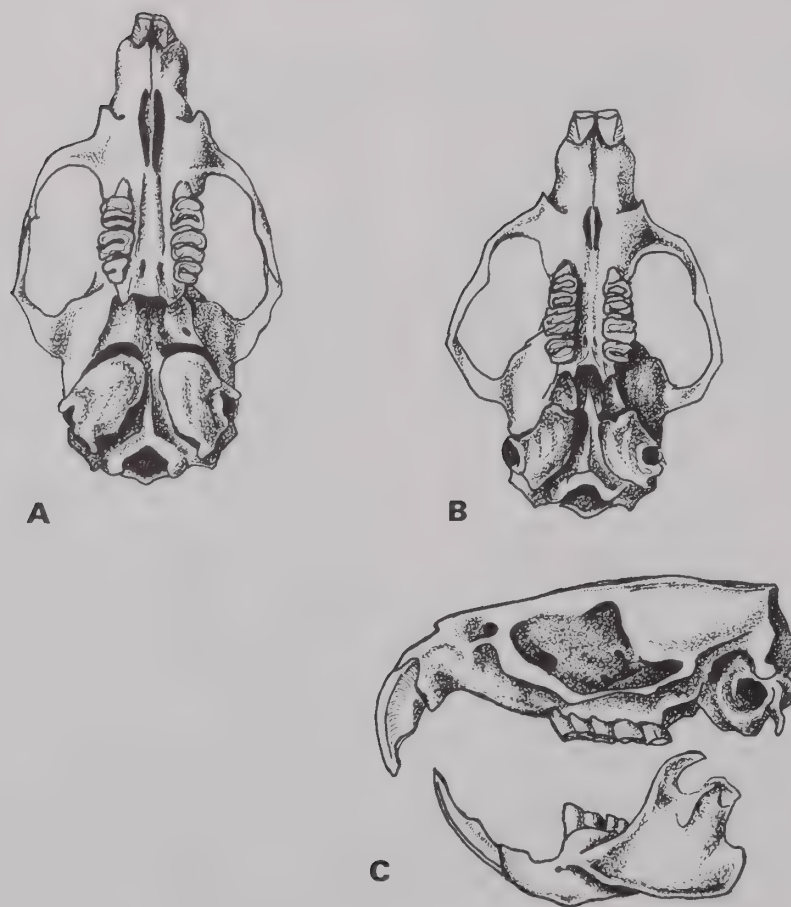


Fig. 72 Showing ventral view of skulls of:  
 A. *Bandicota bengalensis*.  
 B. *Nesokia indica*.  
 These are drawn to the same scale. Note very broad powerful incisors with elongated palatal foramen in *Bandicota* and much reduced palatal foramen in *Nesokia*.  
 C. Lateral view skull and mandible of *Nesokia indica*.

weighing as much as 370g (13oz). However, a captive specimen from Sind attained 550g liveweight in one year. In a series of 15 specimens from southern Sind and northern Punjab the head and body length averages 183mm (range 160–210mm). The tail averages 157mm (range 131–180mm). The hind foot averages 35mm (range 29–38mm) and the ear averages 22mm (range 18–24mm). In a study of rat populations around Calcutta it was found that *B. bengalensis* averaged slightly smaller in size than *R. norvegicus* (Spillet, 1968). Females have 12–18 mammae which are not grouped in pairs so that there are often more on one side than on the other.

**Distribution and Status:** This oriental faunal species has only invaded Pakistan in southern Sind and the Himalayan foothill zone in the north east and is obviously dependent on mesic conditions. It seems to need damp soil for burrowing and typically favours embankments around rice cultivation. It also has adapted to live in the inter-tidal mangrove zone and exhibits commensal tendencies in some Indian cities though it has apparently not colonized Karachi. It avoids sand-dune areas or dry rocky regions.



*Bandicota bengalensis* Known distribution  
Probable range

Distribution Map 102 Lesser Bandicoot or Indian Mole Rat.

Early records show that the Lesser Bandicoot was collected around Umarkot, Thatta, in the extreme north of Jacobabad District of Sind and around Jathi and Ketu Bandar in Thatta District (Murray, 1884).

Paradoxically, with the spread of irrigated cultivation in Sind and the construction of elaborate canal systems and barrages across the Indus (Roberts, 1972) the available suitable habitat for this rat has diminished due to reduced effect of annual flooding from the river. Extensive rice growing tracts around the Indus mouth which depended on such annual inundation have become saline and barren. Trapping operations carried out in 1972 by me around Ketu Bandar failed to reveal the presence of *Bandicota* though it has been trapped from Karachi Port area and around the mangrove creeks even in recent years.

In the main rice growing tracts east of the Indus, in Thatta

District, it is however, still extremely abundant and a major pest of growing rice crops. Jati-Badin, Ladium and Chuhar Jamali sub-divisions are all severely infested with this rat.

It also occurs sparsely in Dokri and Warah subdivisions of Larkana District, west of the Indus but has not apparently been able to spread further north into Sukkur and Jacobabad Districts where equally suitable habitat with extensive paddy cultivation also occurs.

It does not seem to have spread to any of the dryer regions of northern Sind or Bahawalpur or the southern Punjab. However it occurs throughout the rice-growing tract of Sialkot and particularly around Pasrur. It was also trapped by the University of Maryland Expedition around Rawalpindi and it occurs around Rawal Lake. It appears to have extended up the Jhelum valley into Azad Kashmir. A specimen was collected below Barian near the Jhelum River. It has also been collected around Abbotabad, and further west at Amandara in the Malakand District and around Peshawar in the North West Frontier Province. So far, there are no records from around Lahore, nor does it appear to have spread westwards into the Salt Range.

Outside of Pakistan it is more usually associated with warmer subtropical regions but it has penetrated into the Vale of Kashmir in the Himalayas, where rice is extensively grown in summer. It occurs throughout India, Ceylon, Nepal, Burma, Malaysia and Indonesia.

Because of its habit of storing food grains underground and its ability to breed rapidly it still is locally a serious agricultural pest in parts of southern Sind and the north east Punjab (Wagle, 1927). Rice cultivation in lower Swat, Hazara District and Sialkot has probably enabled this species to spread throughout the north west Himalayan foothill regions but conditions there are apparently not entirely suitable for its extensive multiplication due to long dry seasons and paucity of succulent vegetation during the winter months. There is some evidence of its being a pest in grain stores in Peshawar (U.S.A.I.D. report, unpublished).

**Biology:** This is a very prolific rat which can be quite destructive to food crops when their numbers build up under favourable conditions. Its habits have therefore been well studied and documented.

It is normally a nocturnal rodent. They are not gregarious and are in fact extremely aggressive rodents. They excavate very extensive burrow systems but an adult will not tolerate the presence of another Bandicoot in the same burrow. One individual's burrow commonly has three or four openings which may be concealed under bushes or under clumps of grass but are usually revealed by the presence of huge heaps of loose excavated soil by the burrow. The underground runways are extensively interconnected and this loose soil is pushed outside two or three of these openings. This habit has probably given rise to the trivial name Mole-Rat though it does most of its nocturnal food gathering above ground. A typical burrow system investigated by Dr. Jerdon (1874) had eight separate entrances with six branching underground passages and several enlarged chambers in which food was stored. Interconnecting burrows ramified over a distance of over 4.3m (14ft). Mention has already been made of this rat's fantastic digging ability. Six large holes were found excavated through the solid concrete floor of a store in Rangoon which had been made by this rodent (J. Harrison, 1966). In rice cultivation, they make well worn and conspicuous runways through the standing crop and their burrows honeycomb the intervening embankments.

The principal food of this rat is rice in both Sialkot Dis-



trict and Sind. They eat the succulent shoots when the plants are about 45.7cm (18in.) tall and where the population of this rat is high, whole fields of planted rice can be entirely cut down in this way. They also eat the grain heads when they are at the soft and milky stage, and cut off whole panicles when the rice is ripe, dragging this into their underground stores. Piles of rice weighing up to 453g (1lb) have been taken out of such underground food stores (Jerdon, 1874). During the winter and spring when rice is not available they subsist largely upon the succulent roots of 'dab' grass (*Eragrostis cynosuroides*) as well as the roots and tubers of 'dher' (*Scirpus subulatus*) which flourishes in borrow pits and swampy areas in Thatta District of Sind. They also feed on the reed mace (*Scirpus maritimus*) and in the summer months feed upon the seeds of sorghum and millet crops (*Pennisetum typhoides*) (Wagle, 1927). In other parts of India their underground food stores have been found containing whole fruits of the eggplant (*Solanum melongena*) and the ochra (*Hibiscus esculentus*). It can thus be very destructive of crops. In mangrove biotope it must be able to subsist on the succulent leaves of *Salsola foetida* and possibly it also feeds partly on fiddler crabs (*Uca* spp.) which swarm on the mud flats. During the rice growing season they make temporary burrows in the paddy fields but in the winter there is a local migration away from paddy fields towards grassy embankments in Sind (Wagle, 1927). In Rawalpindi District it subsists on the rhizomatous stems and roots of grass and sedges in damper regions.

The Lesser Bandicoot breeds throughout the year and females bear large litters, so that they are very prolific. In Sind the largest litters were recorded from September to November when 14–18 young per litter were common. During the rest of the year 5–10 young were more usually produced (Wagle, op. cit.). In detailed studies carried out on this rodent around Calcutta it was found that the average litter size was 6.2 and the average number of litters per mature female per year was between 10 and 11. Out of a great number of records it was found that 69 young were produced per female per year (Spillet, 1968). It is no wonder that with such fecundity, Bandicoots can build up to pest proportions under favourable conditions. In another study it was found that females become sexually mature when three months of age and even with their first litter produce as many as nine offspring (Krishna, 1931). The newly-born young are naked, pink in colour and blind at birth, they weigh 3–5g ( $\frac{1}{16}$ – $\frac{1}{8}$ oz) and measure approximately 35m (1 $\frac{3}{4}$ in.) in length. Their eyes open after 14 days and by the twenty-eighth day they are fully weaned and leave the nest (Krishna, 1931).

This rodent, as already indicated, is quite fierce and aggressive. They are capable of a number of vocalizations and emit a grunting noise when angry. When disturbed or threatened they lay back their ears and erect their hairs. I have observed that a captive specimen rushed at the wire mesh of its cage when a human being approached and gave evidence of trying to attack through the wire netting.

Being so abundant they must at times be an important food source for the smaller carnivora as well as for those snakes which favour areas subject to periodic flooding. Being a bold and aggressive rodent it is probably able to defend itself against smaller carnivora and water snakes of the genus *Natrix*, but the Rock Python (*Python molurus*) and the Cobra (*Naja naja*) both occur in the Indus riverine tracts, and so do the Jungle Cat (*Felis chaus*) and the Indian Fox (*Vulpes bengalensis*). All these predators are big and strong enough successfully to overcome the Bandicoot. It is supposed that, before the Indus River was controlled,

heavy flooding in the summer months also had a marked effect in controlling the population of this rat in Thatta district of Sind. They can swim very well, however, and readily take to the water, and probably this species is not so susceptible to flooding as *Nesokia indica*. A captive specimen when placed in a glass jar, swam continuously without support for 60 hours (Wagle, 1927).

### Genus NESOKIA Gray, 1842

This is a monotypic genus containing only one species though formerly all the Bandicoot rats were placed in this genus. As indicated in the keys, *Nesokia* is separable from *Bandicota* by the shorter palatal foramina of the former (see Fig. 72). Also *Nesokia* has eight mammae in four regular pairs along the ventrum, whilst *Bandicota* has from 16 to 18 in two irregular rows.

### Key to the Genus and Pakistan Species of NESOKIA

Dental formula: incisors, 1/1; canines, 0/0; pre-molars, 0/0; molars, 3/3.

Medium sized ratlike rodents with tail always less than 66 per cent of head and body length. Ears small and inconspicuous. Females with four pairs of mammae. Skull short and broad with very broad pale yellow upper incisors which are prurodont. Palatal foramen short — generally about 5mm long.

... *Nesokia indica*

### NESOKIA INDICA

*Nesokia indica* Gray and Hardwicke, 1832; Short-tailed Mole Rat (see Illustration 81).

Synonym *Nesokia hardwickei* Gray, 1837;  
and *Nesokia buttoni* Blyth, 1846; Hutton's Mole Rat.

**Description:** This is a smaller rodent than *B. bengalensis* but like the latter is typically rat-like in form with a naked scaly tail, robust body, deep muzzle and relatively small naked ears. In the hand it can be distinguished from *Bandicota* or *Rattus* species by its relatively shorter tail which never exceeds 70 per cent of the head and body length. Also by its prominent broad incisors coated with pale enamel. The body fur is generally much softer than the fur of *B. bengalensis*. Generally it is dark greyish-brown varying to reddish-brown with the belly fur greyish-white and rather lighter in tone than the underside of *B. bengalensis*. Specimens from southern Baluchistan are of a paler more sandy colouration than specimens from the Punjab. The head has a less pointed muzzle than that of *Rattus* species. The upper pair of incisors are prurodont. This feature shows adaptation towards a fossorial existence and this rodent largely uses its teeth in excavating its underground tunnels. The anterior surface of the incisors is smooth and coated with very pale orange enamel being almost ivory coloured in most specimens. The molars or grinding teeth have very flat crowns with no hint of any cusps (see Fig. 77). The fore-feet are noticeably large and well developed with conspicuous long claws which assist in digging. The vestigial thumb on the fore-foot is clawless.

Average dimensions of 20 specimens from Pakistan is as follows. The head and body length averages 165mm (range 150–180mm) and the tail averages 119mm (range 110–129mm), the hind foot averaging 32mm (range 23–36mm)

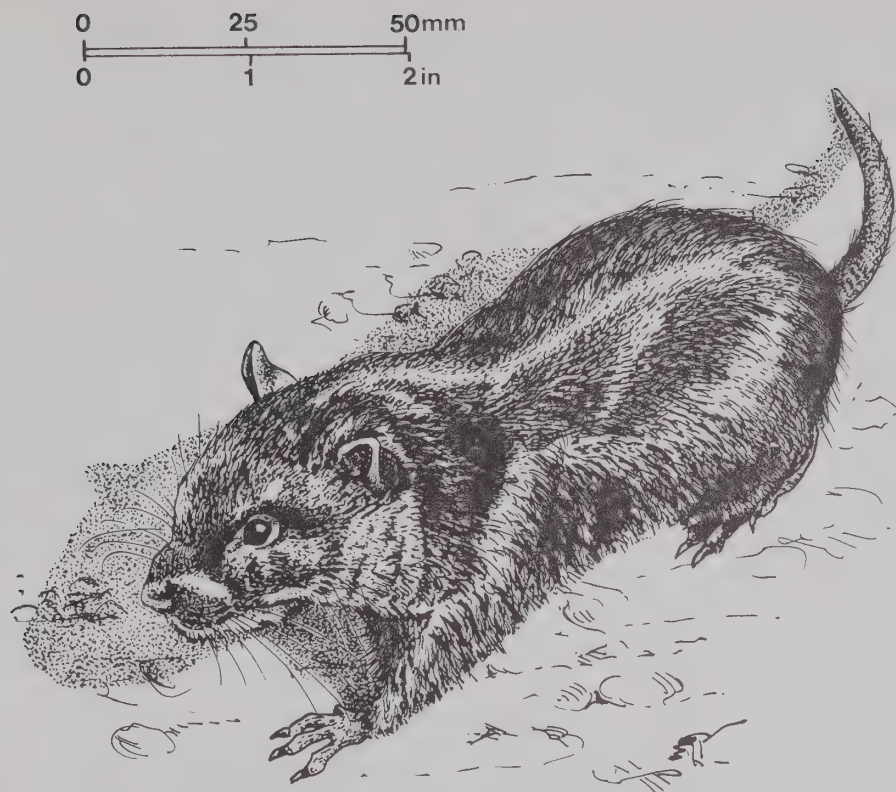


Illustration 81 *Nesokia indica*: Short-tailed Bandicoot Rat or Short-tailed Mole Rat. (Based on live captive specimens from near Bahawalpur, Bahawalpur Division.)

and the ear averaging 19mm (range 16–22mm). Adult specimens vary in weight from 112–177g (4–6¼oz).

**Distribution and Status:** This rodent requires fairly firm damp soil to burrow in and succulent grass roots or underground bulbs to feed upon. Given these two conditions it is widely adaptable and has penetrated into mountainous areas alongside streams and has also spread throughout the Indus plain where irrigation channels have provided suitable conditions for burrowing. It is entirely absent from sand-dune or extensive desert areas but is not so dependant upon mesic conditions as *B. bengalensis* which is characteristically associated with flooded paddy fields.

The Short-tailed Mole Rat is extremely widespread throughout all cultivated regions where there is irrigation and has been trapped throughout Sind, the Punjab and most of the broader valleys in Baluchistan. It is common around the vicinity of Quetta in irrigated orchards. It has been trapped around Panjgur in the Mekran as well as Kalat, and surprisingly at Wam at nearly 2150m (7000ft) elevation in north east Baluchistan (Anderson, pers. comm.). This is considerably higher than the upper limit of 1500m (4900ft) given by E. P. Walker (1964). It occurs around Bannu, Kohat, Mardan and Peshawar and probably extends into the Vale of Swat. The University of Maryland Expedition trapped it near Chitral.

Outside of Pakistan its distribution shows it to be essentially a palearctic rodent in contrast to *B. bengalensis*. It has been trapped almost throughout Afghanistan except in the central desert regions (Hassinger, 1968) and it also occurs throughout the plains of Iran (Lay, 1967). In Russia it is confined to the Amu-Darya Basin up to the Aral Sea as well as in southern Turkestan bordering Afghanistan (Flint

et al., 1965). It extends westwards through Arabia (where it is rare) into Israel and Egypt. Eastwards it has only extended into East Punjab, Rajasthan and the outer Himalaya regions around Kumaon in India.

This is one of the most abundant rodents in agricultural



*Nesokia indica* [stippled] Known distribution  
[cross-hatched] Probable range

Distribution Map 103 Short-tailed Mole Rat.



areas and often does considerable damage to growing crops as well as causing breaches in irrigation channels. Considering its abundance it is surprising that its biology has not been studied anywhere in Pakistan nor have any effective measures been devised for its control.

**Biology:** *N. indica* though apparently closely related phylogenetically to *Bandicota* species, is somewhat distinct ecologically, being more fossorial than the latter. There is also no evidence that they make underground food stores. It is basically an inhabitant of palearctic regions and able to adapt to low temperatures at quite high altitudes because of its largely subterranean feeding habits.

They share the same aggressive disposition as *B. bengalensis*. Individuals lead a solitary existence maintaining exclusive occupation of one particular burrow system. These burrows are more extensive than any other known fossorial rodent of similar size. Generally they consist of tunnels quite close to the surface (15cm (5 $\frac{1}{2}$ in.)) which may ramify up to 24m (80ft) in length. They no doubt use such tunnels partly as foraging passages. Mounds of loose earth are pushed up to the surface at intervals along such tunnels. These mounds conceal the entrances or exits of these burrows and have earned *Nesokia* its trivial name Mole Rat. Some of the burrow systems may extend to a depth of 60cm (23 $\frac{1}{2}$ in.) below the earth's surface and these are used as living quarters. They excavate chambers in these underground burrows, some of which are lined with finely chewed soft grasses. They also characteristically plug the opening or exit of their burrows and make plugs or septa of chewed earth at intervals along their tunnels.

*N. indica* is largely herbivorous in diet and seems to feed principally upon the roots and stems of Dab Grass (*Eragrostis cynosuroides*) which typically grows along the embankments of irrigation channels. Since it rarely emerges on the surface of the soil, it is supposed that seeds, grains and fruit form an insignificant part of its diet. Studies of this rat in Sind (Wagle, 1927) as well as examination of stomach contents of specimens trapped in Khanewal, Bahawalpur and Islamabad indicated that the diet comprises finely chewed material resembling grass roots and stems. They appear to have intermittent periods of activity during both day and night and being fossorial are not exclusively nocturnal. I have on several occasions heard *N. indica* actively feeding on the subterranean stems of a clump of sedge grass in the early forenoon and also observed a specimen sunning itself on the top of its earth excavation at 7.30am. According to all available evidence adult specimens very rarely emerge above the surface of the ground, but sub-adult specimens may however be more venturesome. An immature specimen was trapped above ground and another one was found in the stomach of a Jungle Cat (*Felis chaus*) in Lyallpur District (Taber et al., 1967).

Breeding activity appears to continue throughout the year in this Mole Rat. Fresh killed specimens from the southern Punjab had six and eight fetuses respectively in December and January. Specimens trapped in Lyallpur in November were either lactating or pregnant (Taber et al., 1967). In Iran, specimens trapped in October appeared to be pregnant and another December trapped specimen in Iran had 16mm (5 $\frac{1}{2}$ in.) embryos (Lay, 1967). No litters exceeding eight young were found during studies in southern Sind (Wagle, 1927). In Iraq pregnant females were trapped in March and April (Walker et al., 1964). The young are born naked and blind in an underground nest chamber lined with soft material. As they grow hair the young are distinctly darker brown in

colour than the adults. Nothing is known about the period of gestation or length of time that the young are suckled. The lesser number of mammae in the female and its ability to colonize the very restricted biotope in semi-arid regions alongside stream banks would seem to indicate that they have adapted to become less prolific than *B. bengalensis*.

Captive specimens readily attempt to attack and bite and they also squeak when angered in the same manner as *B. bengalensis* when threatened. Blanford records digging two pairs out of one burrow system (Finn, 1929) and this may have been a family group. Captive born young were observed by me to be milder in disposition than their mother and became quite tame. It is interesting that P. V. Wagle (1927) also reported that individuals varied in disposition, some freshly captured being quite submissive and quiet.

The so-called Two-headed Snake (*Eryx johmi*) and the Sand Boa (*E. conicus*) have been observed entering loose earth mounds excavated by *Nesokia*. These are fierce aggressive snakes and certainly feed on small rodents (Minton, 1966). Because of their fossorial habits *Nesokia* probably escape the attention of most carnivora though Dr. Taber shot a Jungle Cat (*Felis chaus*) which had fed on a young *Nesokia* (see above). Probably they are much subject to mortality from periodic flooding in their original riverine habitat and such natural hazards restrict their numbers.

The spread of irrigation in Sind and Punjab has created favourable conditions for *Nesokia* which has undoubtedly spread and multiplied as a consequence. Their burrows in canal embankments frequently give rise to breaches which are of such common occurrence as to cause serious loss of precious irrigation water as well as damage to crops. Their burrow systems are so extensive that they would be very difficult to control by fumigation, as anyone who has tried to smoke them out of their burrows can testify. I have observed, when excavating their burrows in Bahawalpur and in Jacobabad District, that they remain hiding until the last, instead of trying to escape to the surface, and are thus not difficult to capture.

#### Key to the Family CRICETIDAE — Hamsters, Gerbils and Jirds

A very variable family distinguished by the cheek teeth which are either bi-serially cuspidate with only two rows of cusps, or if with flattened crowns, showing wide folds between laminae. Tail usually well clothed with hairs.

#### Genus CALOMYSCUS Thomas, 1905

This is a monotypic genus which has puzzled many taxonomists. The single species lacks the one essential feature of the Hamsters, i.e. cheek pouches. It also shows certain similarities to the New World mice of the genus *Peromyscus*, but recent studies indicate that there is no close relationship (Hooper and Musser, 1964). Because of their lack of close relationship with neighbouring rodent forms they have been considered as a relict population from a more primitive *Cricetine* ancestor which may be on its way to gradual extinction (Osgood, 1947).

#### Key to the Genus and Pakistan Species of CALOMYSCUS

Small size (head and body length 72–92mm) with large circular ears (17 to 20mm long and about one-quarter of head

and body length) and tail longer than head and body length. Tail bears dorsal crest of longer dark hairs and is bi-coloured. The cheek teeth are cuspidate. No whitish spot behind eyes or ears.

... *Calomyscus bailwardi*

### CALOMYSCUS BAILWARDI

*Calomyscus bailwardi* Thomas, 1905; Mouse-like Hamster or Long-tailed Hamster (see Illustration 82).

**Description:** A relatively small mouselike rodent with a comparatively long well-furred tail and conspicuously large rounded ears. Superficially they look closely like *Gerbillus nanus* and may indeed be trapped in the same regions. However the ears are relatively longer than the latter species and average 18mm ( $\frac{11}{16}$ in.) compared with 14mm ( $\frac{9}{16}$ in.) length of *Gerbillus nanus*. Furthermore there is no trace of any white patch behind the ear and behind the eye as in *G. nanus* (see Fig. 69). The body fur is relatively long and soft consisting of mixed buff and greyish black hairs in the dorsal area with the

on its inner aspect as compared with *Peromyscus* which has only two roots on the inner aspect of the first molar. Otherwise the cheek-teeth lack close ridges of hard dentine and show traces of cusps so that they are similar in appearance to the teeth of the Deer Mice of North America (*Peromyscus*) (see Fig. 73). The average variation of head and body length of 15 specimens from Baluchistan and the North West Frontier Province was 80mm (range 72–92mm), with the tail averaging 86mm (range 74–98mm), the hind foot averaging 20mm (range 18–22mm) and the ear averaging 17mm (range 15–20mm). The long delicate vibrissae measure up to 21mm ( $\frac{13}{16}$ in.). The female has six mammae. Eight specimens varied from 15–30g (average 20.4g) in body weight.

**Distribution and Status:** This rodent favours mountain steppe regions and is absent from low valleys. It is more or less sympatric with the Persian Jird and will characteristically be found on the driest rocky hillsides from about 610m (2000ft) up to 3100m (10,000ft) elevation.

*C. bailwardi* was first discovered in southern Baluchistan when Colonel Hotson trapped 14 specimens from around



Illustration 82 *Calomyscus bailwardi*: Mouse-like Hamster.  
(Based on captive specimens from Ziarat, north east Baluchistan.)

lower cheeks, throat and belly being pure white. As in *Gerbillus* species the dividing line between the buff flanks and the white belly is quite sharp. Specimens of this Long-tailed Hamster from the Suleiman Hills and Parachinar have more blue-grey fur in their dorsal pelage whilst specimens from southern parts of Baluchistan are more sandy-yellow in colouration. The tail is generally slightly shorter than the head and body length and is well covered with hairs throughout. The tail is markedly bi-coloured with the ventral surface white and the dorsal surface consisting of longer hairs of buff, white and black mixture. The distal one-third tends to be more bushy. The muzzle is very sharp and pointed with the naked ears pinkish-grey or slaty in colouration. The hind-leg is relatively elongated and the upper surface of all digits is white. The undersurface of the hind foot is naked with five digits (see Fig. 70), the fore-feet having five digits with a vestigial clawless thumb. The claws are rather small and delicate in this mouse. The upper incisors are smooth on their anterior surface being covered with yellowish-brown enamel. The first molar or cheek-tooth has one more root

Kalat and the Mekran in 1918 (JBNHS Report No. 32, 1920). It is very poorly represented in the British Museum or in the Bombay Natural History Society Museum collections despite being widespread and common throughout the mountainous regions of Baluchistan, Waziristan and the Kurram Agency. It has been trapped from Panjgur in southern Baluchistan, the Chiltan Hills and Harboi, south of Kalat. I have found it readily entering traps around Sandeman Tangi, Ziarat, Fort Monroe and the Uruk valley north of Quetta. The University of Maryland Expedition collected it around Parachinar. In Pakistan it has not been recorded north of this region or east of the Indus.

Extra-limally it occurs in the mountainous regions of Eastern Afghanistan around Kabul and the Shibar Pass. It also occurs throughout the northern mountain regions of Afghanistan and has been trapped around Kandahar (Hassinger, 1968). In Iran it has mostly been recorded from the Elburz and Zagros Mountains (Lay, 1967). In the USSR it occurs only in Turkmenistan in the Kopet-Dag mountains bordering on Iran (Bobrinskii et al., 1965). It has not been recorded in



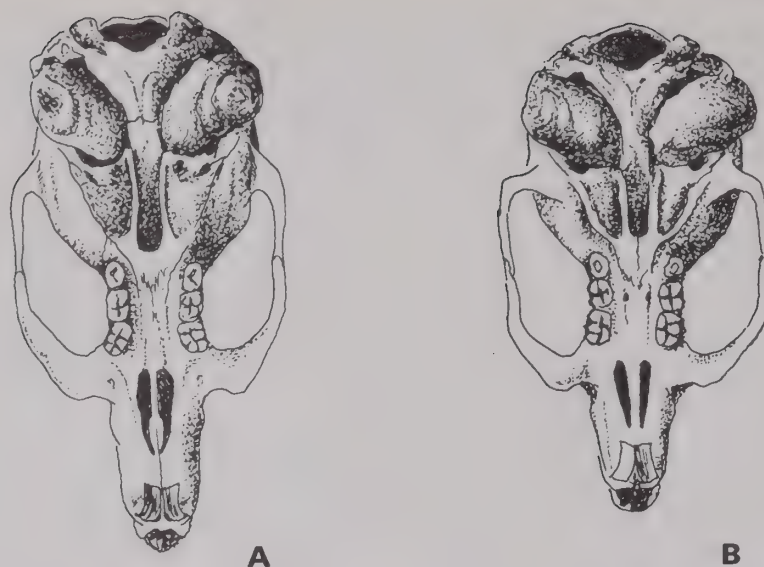


Fig. 73 Showing ventral view of skulls of:  
A. *Cricetulus migratorius*.  
B. *Calomyscus bailwardi*.

Note cheek teeth have two parallel rows of cusps and tympanic bullae are somewhat inflated and enlarged. These are drawn to same scale.

any other country so that its total world distribution is comparatively restricted.

Inhabiting only arid rocky hill slopes, this little mouse is of no economic importance.

**Biology:** Though not highly social it seems to be quite gregarious in favourable regions, sharing burrows or sheltering between natural rock crevices. They also have been trapped in burrows which were excavated by *M. persicus* and they particularly seem to favour stone walls and embankments of small fields or terraced cultivation.

They are partly graminivorous as well as herbivorous and have the habit of collecting little caches of seeds which they

conceal under stones or in their burrows. They have also been observed feeding on buds and flowers of various forbes. These stores of food are no doubt utilized during the winter months as this rodent lives in regions where the climate is very harsh during the winter and where snow often thinly carpets the ground. In the Uruk valley near Quetta I have found that their presence could often be detected by the discovery of little piles of cracked grass seeds and thistle buds found under overhanging rocks and the same characteristics have been recorded in Iran (Lay, 1967). As far as is known they remain active throughout the year and there is no period of hibernation. Captive specimens ate both chopped vegetables as well as millet seeds and also drank water though this can rarely be available to them in the wild.

Observations on captive specimens indicate that they are very susceptible to temperature changes and in colder weather they are often active in the afternoon and early part of the morning. It is also recorded to be partially nocturnal during the warmer summer months in other parts of its range (Walker et al., 1964) and this may be a response in high day temperatures. Despite living in cold upland regions it was found that specimens live trapped in late November at an ambient temperature of 32°F (0°C) frequently succumbed to exposure within the space of the night.

Breeding is believed to be confined to the warmer months from spring to late autumn. A wild caught specimen from Ziarat in Baluchistan trapped on 24 March produced two young on 6 April. They were pink, blind and naked at birth but quite active. They developed very quickly being fully covered with fur by ten days and nearly three-quarters of the size of the mother though at this time they were still suckling. Cannibalism was also observed in another captive female which ate its young. In the wild it appears that young are born in nests which are concealed in rock crevices and woven into a globe using fine grasses and sheep's wool, etc. Dr. Lay (1967) describes such a nest found in Iran at 3400m (11,000ft) elevation. Lactating females were trapped in Iran in August and the end of September. Litters of two, four and seven young were also discovered in Iran. E. Walker (1964) records that only some females produce two litters a year and that they are not fully mature until eight months of age. It is pro-



Distribution Map 104 Mouse-like Hamster or Long-tailed Hamster.

bable that in adaptation to their harsh environment they are not very prolific though judging from trapping successes they are certainly quite abundant in regions where they occur. In Fort Monroe region 50 per cent of the traps I put out in one night were visited by this rodent.

*C. bailwardi* is a very agile mouse, able to jump amongst tumbled boulders with considerable agility and also climb. They are nervous in disposition and timid. It would appear that more than one individual occupies the same burrow or shelter judging from their inclination to sleep huddled together when in captivity.

Predators on this small mouse probably include the Pallid Scops Owl (*Otus brucei*) as well as the Stone Marten (*Martes foina*), possibly also the Marbled Pole Cat (*Vormela peregusna*) which certainly inhabits the same biotope around Parachinar. In Ziarat, Baluchistan, the Rat Snakes (*Sphalerosophis atriceps* and *Z. baveregeri*) and the Euphratic Viper (*Vipera lebetina*) are common, and these snakes no doubt prey upon *Calomyscus bailwardi*.

#### Genus CRICETULUS Milne-Edwards, 1867

This genus comprises seven species found in the semi-arid loess and mountain steppe country extending from central Asia across to the Caucasus and eastern Mediterranean. They all possess a short tail which lacks any terminal tuft and are rather short-limbed rodents with blunt muzzles and well-developed cheek pouches.

#### Key to the Genus and Pakistan Species of CRICETULUS

Dental formula: incisors 1/1; canines 0/0, pre-molars 0/0, molars 3/3.

Tail slim, fully furred and about one and a half times the length of the hind foot. Cheek pouches present. Belly fur pure white sharply contrasting with pale grey dorsal fur. Cheek teeth have bi-serially cuspidate crowns (see Fig. 68).

... *Cricetulus migratorius*

#### CRICETULUS MIGRATORIUS

*Cricetulus migratorius* Pallas, 1773; Migratory Hamster or Grey Hamster (see Illustration 83).

**Description:** With its blunt muzzle and short well furred tail this rodent generally looks more like a vole than a mouse. In contrast to all other rodent species found in Pakistan it has very characteristic grey fur without any brown or buff undertones. The fur is relatively short, soft and dense and sharply divided along the flanks from the pure white fur over the lower cheeks, throat and belly. Specimens from Gilgit and the north average slightly larger in size with the bluer-grey pelage. Specimens from Baluchistan are generally a slightly paler more yellowish-grey. The tail is not noticeably paler on the ventral surface but is overall more silvery-grey and lighter in tone than the body fur. There is no trace of any terminal tuft of longer hairs to the tail which ends rather abruptly, not being tapered. Compared to *C. bailwardi* the ears appear smaller but still remain conspicuous. Also the hind foot is less elongated, being roughly equal in length to the ears with both ear and hind foot approximately one-fifth of the head and body length. The ear is fairly well covered with short hairs on both surfaces of the pinna. The eyes are relatively small and the vibrissae consisting of mixed black and white hairs are comparatively short.

Examination of the skull reveals that the grinding teeth are markedly bunodont which at once separates this hamster from the true voles (see Fig. 73). The incisors are ungrooved on their anterior surface, coated with pale yellow enamel and of medium thickness and width. The tympanic bullae of *C. migratorius* are considerably larger than those of *C. bailwardi* and also the palatal foramina are longer when the two skulls are compared. The first molar in the upper tooth row of *C. migratorius* has six distinct cusps whilst the first molar of *Calomyscus* has only five cusps (see Fig. 73). The last or third molar in the upper jaw bears traces of two cusps and is quite conspicuous in *C. migratorius*, whereas in *Calomyscus* the



Illustration 83 *Cricetulus migratorius*: Migratory Hamster.  
(Based on captive specimen from Ziarat, Baluchistan.)





Fig. 74 Showing appearance of *Cricetus migratorius* from the front when its cheek pouches are stuffed full of food.

third upper molar is much reduced in size being ring-shaped on its surface.

Out of a series of 25 specimens from Baluchistan and Gilgit the head and body length averages 105mm (range 94–122mm), the tail averages 32mm (range 21–45mm), the hind foot averages 17mm (range 15–19mm) and the ear averages 20mm (range 17–23mm). Seven adults varied from 31–50g (average 39.6g) in body weight. Females have eight mammae.

**Distribution and Status:** The Migratory Hamster in Pakistan is characteristically associated with mountain steppe country generally with *Artemisia maritima* and stunted *Juniperus*. They also occur in valley bottoms and may frequent terraced cultivation and even the outskirts of mountain villages. In Baluchistan there appears to be no record of its occurrence below 1350m (4500ft) though it occurs down to sea level in Iran (Lay, 1967). In Naltar Valley in Gilgit it has also been trapped in Himalayan dry temperate forest biotope.

Absent from the Himalayan moist forest regions it is widely spread in the dryer mountainous areas of Baluchistan. They have also been collected in Waziristan and the upper Kurram Valley in the North West Frontier Province. They are apparently not common in the purely desert regions of southern Baluchistan preferring valleys with some cultivation.



*Cricetus migratorius* Known distribution  
Probable range

Distribution Map 105 Migratory or Grey Hamster.

They have been trapped in Kalat State, at Ladha and Saranan and Pishin District as well as around Ziarat in the north. In Baluchistan they are often sympatric with *Meriones persicus* as well as *M. libycus* and in the northern Himalayan regions they occur with *Apodemus sylvaticus* and *Ochotona roylei*. They occur throughout Gilgit and Baltistan including the Karakoram Mountains. They have been trapped above Phandar Lake in Yasin at 3200m (10,500ft) elevation. They also have been trapped around Naltar in dry temperate coniferous forest.

Outside of Pakistan, they are widespread through the plateau regions of Asiatic Russia, westwards to the Ukraine down through Trans Caspia and eastwards into Siberia (Flint et al., 1965). In Afghanistan they are widespread on stony hillsides from 600 to 3600m (2000–12,000ft). They only appear to be absent from the southern region of Afghanistan (Niethammer, 1965). They occur throughout northern Iran in the higher plateau region (Lay, 1967). They also extend westwards through Iraq, Syria, the Lebanon and Greece.

Because these rodents are largely omnivorous and forage over a large territory they do not seem to do much damage in the arid mountainous regions where they occur and it would appear that they never obtain a very high population density anywhere in Pakistan. There is no evidence of their doing any damage to agricultural crops.

**Biology:** The Migratory Hamster is not only different in appearance from *C. bailwardi* in having a very short untufted tail and well developed cheek pouches, but it is also markedly different in temperament. It is a bold and inquisitive rodent which has the reputation of being aggressive and even savage if cornered. It will not hesitate to enter dwellings occupied by man in search of food. Captive specimens attacked and ate Jerboas and frogs which had been placed in the same cage (Lay, 1967). Members of this genus have been characteristically described as defending themselves by rolling over on their backs and opening the mouth to expose formidable incisor teeth (Walker et al., 1964). Migratory Hamsters show partly commensal tendencies and may be trapped inside Gilgit town as well as around Quetta. They are generally nocturnal in activity, sheltering by day in burrows which they usually excavate for themselves. However in Gilgit I have twice seen them scampering over stone walls during daylight hours and in the early spring and late autumn they come out to forage before darkness falls. In the Kargah Nullah in early November when camped at about 2150m (7000ft) one specimen entered our tent at about 4.30pm even though my companions and I were talking loudly at the time. They have the reputation of wandering considerable distances in their search for food and being much less territorial than most other rodent species. They are largely graminivorous in feeding but no doubt eat any small vertebrates which they can overcome as well as insects. Captive specimens readily ate meat. They also feed on buds and young shoots of plants in the spring. The most fascinating characteristic of this rodent's feeding habits relate to its cheek pouches. Normally when out foraging they cram their cheek pouches with chopped vegetable matter, seeds and wild berries. When fully distended their cheek pouches stretch almost to the shoulders and the animal looks quite grotesque when viewed from in front (see Fig. 74). Generally they return to their underground burrows and disgorge these food accumulations in their underground chambers which are used as food stores. They are not highly gregarious and it is believed that one individual occupies a single burrow system. But I have found their burrows in small colonies of five or six in Khushdil Khan

region of Baluchistan. They have frequently been trapped from the base of stone embankments and walls and probably prefer to live in the crevices between such walls.

Most *Cricetulus* species are known to hibernate, but there is no definite information about *C. migratorius*. In Afghanistan they have been trapped during both December and January when foraging above ground which was carpeted with deep snow (Niethammer, 1965) and in the USSR it apparently does not hibernate (Vinogradov and Argyropule, 1941). In Gilgit they have also been observed in early December actively foraging just before dawn around a deserted shepherd's camp site. Probably they do undergo partial hibernation but with frequent wakeful or active spells when they subsist on their underground food stores, and may even be driven by hunger to forage above ground in the winter.

Breeding is probably more periodic or seasonal in this rodent than in many other species living in the same region since the males exhibit a marked hypertrophy of the testes in the early spring lasting until about the middle of May and most litters seem to be produced during the spring and summer months. Captive specimens in the possession of J. A. W. Anderson produced litters varying from four to six mainly from early March to mid April. Sub-adult specimens have been trapped on 26 June in Baluchistan. However in Gilgit sub-adult specimens have been trapped as late as 20 October, indicating a longer breeding period in northern latitudes. In Iran pregnant females were also trapped in October, November and late December. These contained four to seven embryos (Lay, op. cit.). A specimen trapped in Chinese Turkestan contained eight fetuses (Ellerman, 1961), and one trapped in Iraq contained eight embryos in late April (D. L. Harrison, 1972). The newly-born young are reared in an underground nest chamber and are blind, naked and helpless at birth. By the seventh or eighth day they have a visible coat of hair but their eyes do not open until about the fourteenth day and they are not weaned until the third or fourth week. They are thus much slower maturing than *C. bailwardi*. The gestation period is not known for this rodent nor anything about its longevity.

Since these rodents are very inquisitive and wander widely in their foraging they often fall prey to carnivora. Moreover they are comparatively slow in gait and easy to capture even in the open. In Iran this hamster was the most frequently encountered rodent in the stomachs of foxes and jackals examined (Lay, 1967). In Baluchistan the very abundant Hill Fox (*V. vulpes griffithi*) as well as the Stone Marten (*Martes foina*) also probably prey on this Hamster. The Little Owl (*Athene noctua*) occurs in the same habitat also where *C. migratorius* has been trapped in Baluchistan.

This is the only rodent besides *Tatera indica*, *Mus musculus* and *Rattus* species which definitely seems attracted to man's habitations and which is inclined to be commensal. In Gilgit they particularly frequent shepherds' camp sites, and they are not the least bit afraid of exposing themselves in the open away from any shelter or cover during their nightly foraging.

#### SUBFAMILY GERBILLINAE

This is a large group of rodents within the Family Cricetidae which are all adapted to semi-arid conditions and are confined to the semi-desert regions of the Old World, extending from North Africa through the Middle East to central Asia. They are nearly all colonial species with fairly long well furred tails often bearing a terminal tuft of longer hairs. In some

genera the hind feet are strongly developed and they are partially developed towards a saltatorial or hopping gait. In most genera the upper incisors bear longitudinal grooves and the grinding teeth tend to have rather flat prismatic surfaces. The subfamily includes the Gerbils, Sand Rats, Antelope Rats, Jirds and also Pigmy and Giant Gerbil forms.

#### Key to the Subfamily GERBILLINAE

Cheek pouches absent. Tail equal to or longer than head and body and fully furred usually with terminal tuft of longer hairs. Cheek teeth in adults flat crowned and laminate and skull with rather enlarged tympanic bullae.

#### Genus GERBILLUS Desmarest, 1804

Between 50 and 60 species have been described belonging to this genus, the majority of which are found in North Africa. Their taxonomy is difficult since many of these forms are closely similar. It is a pity that the trivial names Jird and Gerbil have been loosely applied to species within the same genera. Generally speaking members of the genus *Gerbillus* are relatively slender rodents with comparatively better developed hind legs than the more thickset Sand Rats or Jirds of *Meriones* genus. *Gerbillus* species are all nocturnal in feeding activity and colonial.

#### Key to the Genus GERBILLUS

Dental formula: incisors, 1/1; canines, 0/0; pre-molars, 0/0; molars, 3/3.

Small rodents with well-developed hind legs and elongated hind feet. Tail longer than head and body and paler on ventral surface. Cheek teeth bi-serially cuspidate in young animals becoming laminate when worn, upper incisors slender and longitudinally grooved and orange. A whitish spot visible in the pelage behind the ears and eyes.

#### Key to the Pakistan Species of GERBILLUS

(i) Head and body length 65–88mm. Tail 95–125mm. Sole of hind foot naked. Tympanic bullae greatly inflated usually over 30 per cent of occipito-nasal length. Dorsal pelage with mixture of black hairs appearing sandy-buff.

... *Gerbillus nanus*

(ii) Head and body 75–100mm. Tail 120–145mm and relatively longer (132mm) on average than tail of *G. cheesmani*. Sole of hind foot hairy. Dorsal fur reddish-tan or gingery-buff without mixture of black hairs. Tympanic bullae moderately inflated averaging 29 per cent of occipito-nasal length.

... *Gerbillus gleadowi*

(iii) Head and body 89–105mm, Tail 110–140mm averaging proportionately shorter (129mm) than the tail of *G. gleadowi*. Sole of hind foot hairy. Dorsal fur reddish-tan or gingery-buff. Tympanic bullae greatly inflated averaging 31 per cent of occipito-nasal length.

... *Gerbillus cheesmani*

#### GERBILLUS NANUS

*Gerbillus nanus* Blanford, 1875; Baluchistan Gerbil  
Synonym *Gerbillus dasyurus indus* Thomas; Wagner's Gerbil

**Taxonomy:** Wagner's Gerbil, *Gerbillus dasyurus* was first described from Syria and North Africa. Subsequently



*Gerbillus* specimens collected from Pakistan during the Bombay Natural History Society Mammal Survey (Thomas, 1920A) were also assigned to *Gerbillus dasyurus indus*. Ellerman and Morrison-Scott (1951) listed this species as occurring in the Punjab. Dr. Taber collected a Gerbil from Lyallpur which was assigned by the British Museum to this species (Taber et al., 1967). The latest view now appears to be that all the Pakistan population of naked soled Gerbils are *Gerbillus nanus* and that *Gerbillus dasyurus* does not occur east of Syria (Petter 1961A, Dr. Lay in lit. and D. L. Harrison, 1972). F. Petter (1961A) believed that specimens from the Indus Valley referred to as *G. dasyurus* were in fact inseparable from *G. nanus*. J. R. Ellerman (1961) in his key to the genus stated that *G. dasyurus* had tympanic bullae generally less than 30 per cent of the occipito-nasal length whereas *G. nanus* had bullae generally 30 per cent of the occipito-nasal length. However he concluded that, 'the two species were not very widely separable from each other and that they seemed to occur together'. *G. nanus* is apparently a polytypic species with several well-defined geographical races (Harrison, 1972).

**Description:** The Baluchistan Gerbil has long slender limbs with the hind foot rather elongated. The tail is roughly 150 per cent of the head and body length and is well clothed with hairs throughout its length, being brownish-buff dorsally and creamy-white ventrally. There is a slight tuft of longer, dark brown and greyish hairs towards the tip. The body fur is sandy-buff with a mixture of dark tipped hairs and the lower cheeks, belly and inside of limbs are pure white. There is a white crescentic area behind the ears as well as around the hind part of the eye (see Fig. 69). The rounded ears are naked and pinkish-brown in colour. The soles of the hind feet are naked in this gerbil. A series of 19 specimens from different parts of Sind, Punjab and Baluchistan had the head and body length averaging 74mm (range 65–87mm) with the tail averaging 112mm (range 95–127mm), the hind feet averaging 23mm (range 20–26mm) and the ear averaging 13mm (range 12–15mm).

**Distribution and Status:** In Sind and southern Baluchistan *G. nanus* generally avoids sand-dune areas and seems to prefer rocky or stony regions with a fairly firm substratum. In the Punjab it occurs in clay flats, and is typically associated with patches of tropical thorn scrub in the Indus plain (Taber et al., 1967). It does occur around the edges of cultivated fields in parts of southern Baluchistan.

The Baluchistan Gerbil is here taken as covering the whole population of *Gerbillus indus* (Thomas, 1920A) and *G. dasyurus* described from the Indo-Pakistan subcontinent.

In Pakistan *G. nanus* seems to have declined with the spread of irrigated cultivation in the Indus plain. It has been collected from Sahiwal, and Lyallpur as well as Bahawalpur and Panjnad. It is more plentiful in regions to the west of the Indus at low altitudes. It occurs throughout Dera Ismail Khan and Dera Ghazi Khan districts. It is relatively common in Dadu and Larkana districts of Sind in the foothill tracts, as well as occurring in the Hub Valley and throughout Las Belas. It is widespread in the Mekran and the lower valleys of Baluchistan. It has been collected at Panjgur, Turbat and Nushki. It has also been collected in south Waziristan. It seems to prefer stony or hilly areas and is more plentiful in the Salt Range than in the alluvial plains. It is absent from extensive desert tracts such as Cholistan and the Thal, where it is replaced by its congener *G. gleadowi*.

Outside of Pakistan, *G. nanus* has been collected from the



*Gerbillus nanus* Known distribution  
Probable range

Distribution Map 106 Baluchistan Gerbil.

southern region of Afghanistan on the borders of Seistan around Kandahar and Qala-i-Kang (Hassinger, 1968). In Iran it seems to occur in two separate populations in south western Iran and again in south eastern Iran (Lay, 1967). Specimens of *G. dasyurus* collected in Iraq appear to be *G. nanus* (Lay, 1967) and it extends westwards through Arabia, and probably into Egypt and the Sudan (D. L. Harrison, 1972). In India it is widespread in Rajasthan, extending south to Gujrat (Prakash and Jain, 1971).

**Biology:** Compared with *Tatera indica* or *Meriones libycus*, with which it may be sympatric this is not a highly colonial species. However they do live in scattered associations and their burrows often occur in fairly close proximity to one another. They excavate their own burrows which are usually rather simple in construction sloping down to a single enlarged underground chamber. Generally this chamber is 0.75m (2–3ft) below the surface. They do not deliberately plug the entrances to their burrows though occasionally soft sand may partially block their burrow mouths.

They are strictly nocturnal in activity and when they emerge at night to forage they often cover quite extensive territory hopping along with short jumps of their hind feet. During the winter months they probably subsist mainly on seeds supplementing their diet with succulent leaves of desert plants. During the summer months they feed on whatever insects are available and it is believed that they are more insectivorous than the *Meriones* species. In Iran *Gerbillus nanus* was found feeding on freshly sprouting grass as well as seeds of *Medicago* (Lay, 1967). Captive specimens do not show any interest in water and can probably derive all the moisture they require from green vegetation and carbohydrate metabolism.

The gestation period is believed to be about 20 days. The young are born naked, blind and very feeble. Their eyes open in the second week and they are weaned at the end of the third week (Prakash and Jain, 1971). In the Punjab Salt Range, juvenile specimens have been trapped in March and April, indicating early winter breeding. In

Iran females of this species were found pregnant in November and suckling young in December (Lay, 1967). Immature specimens were trapped near Lyallpur in late November (Taber et al., 1967). E. Walker (1964) considers that most *Gerbillus* species are polyoestrus and that breeding occurs throughout the year. In Rajasthan litters of 2 or 3 were found in April and June and it is believed that peak breeding activity occurs at two seasons, in summer and winter (Prakash and Jain, op. cit.).

These little rodents are no doubt preyed upon by owls as well as small carnivores. In Afghanistan Dr. Niethammer (1965) found evidence of *Gerbillus nanus* remains in the regurgitated casts of the Eagle Owl (*Bubo bubo*) as well as the Long-eared Owl (*Asio otus*). Both these owls occur in habitats favoured by *G. nanus* in Pakistan, *Asio otus* being a winter visitor. H. W. Waite once shot a Saw-scaled Viper (*Echis carinatus*) which he encountered hanging in the lower branches of a fruit tree at Choa Saidan Shah in the Salt Range. On being cut open this snake was found to have swallowed a whole *Gerbillus nanus* (H. W. Waite, pers. comm., 1967). They are probably preyed upon by other snakes, and Sand Boas (*Eryx johni*) have been observed entering burrows which probably belonged to this species.

*G. nanus* appears to remain active throughout the year, and there is no evidence that they undergo any hibernation or aestivation. In the wild they probably do not survive more than two years but a closely related African species (*Gerbillus gerbillus*) has lived for five years and 14 days in captivity (Crandall, 1964).

## GERBILLUS GLEADOWI

*Gerbillus gleadowi* Murray, 1886; Indian Hairy-footed Gerbil (see Illustration 84).

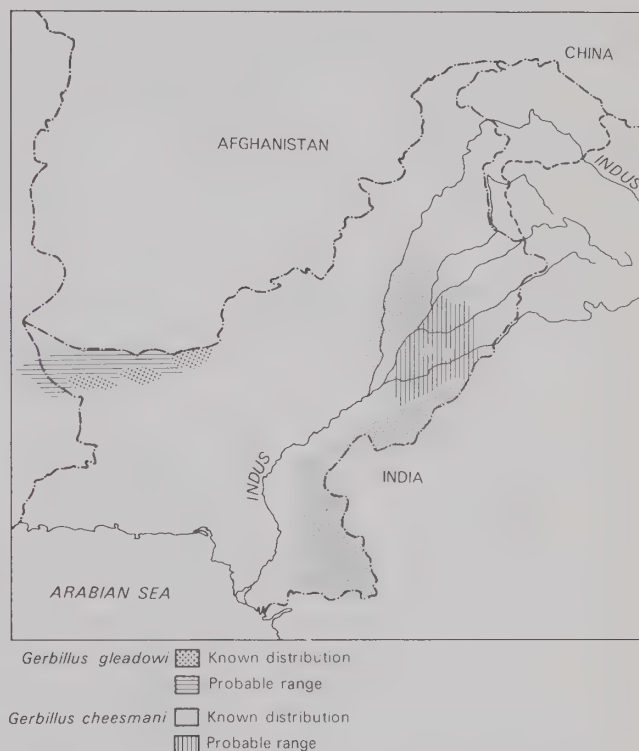
**Description:** This gerbil was first collected by Mr. Gleadow of the Indian Forest Service near Sukkur in 1885. It is a slender delicately-built gerbil with fur of a pale reddish-buff or biscuit colour and pure white hair on the lower cheeks, throat and ventrum. The hind legs are comparatively long and the sole is thickly fringed with hairs in contrast to *G. nanus* (see Fig. 75). The tail, which is about 150 per cent of the head and body length, has a paler creamy ventral surface being reddish-buff dorsally like that of *G. nanus*. The distal one-quarter bears a dorsal crest of long brown and grey hairs. The black eyes are relatively large in this nocturnal rodent and when viewed from in front the muzzle appears rather broad due to radiating stiff hairs. This together with the hairy soles of the hind feet, is undoubtedly a valuable ecological adaptation to living and burrowing in shifting sand-dune areas. Like *G. nanus* it has a whitish spot behind the ears and eyes (see Fig. 69). The females have eight mammae. The skull shows enlarged tympanic bullae and the slender incisors bear longitudinal grooves. The palatal foramina are elongated compared with *Meriones* species.

If a large series are examined, *G. gleadowi* tends to average slightly smaller in size than *G. nanus* within Pakistan territories. Out of 27 specimens from Punjab, Sind and Baluchistan the dimensions were as follows. Head and body length averages 91mm (range 75–102mm) and the tail averages 132mm (range 118–150mm). The hind foot averages 29mm (range 26–32mm) and the ear averages 13mm (range 11–14mm). Adult specimens trapped in November varied in weight from 20 to 28g ( $\frac{3}{4}$ –1oz).

**Distribution and Status:** This gerbil is confined to areas

of sand-dune desert up to the west banks of the Indus River. Typically it is associated with shifting sand-dunes on which bushes of *Tamarix aphylla* and *Calligonum polygonoides* grow.

It occurs throughout Cholistan and the Thal Desert. It also occurs in uncultivated patches and sand-dune regions throughout the Indus alluvial plains including Multan district. It has been collected from Tharparkar District in Sind and across the Indus westwards around Dera Ghazi Khan. It has not been found in any rocky or foothill regions and does not extend northwards into the Salt Range or westwards into Baluchistan. Since they shun cultivation these little rodents are of no economic importance.



Distribution Map 107 Cheesman's Gerbil.  
Indian Hairy-footed Gerbil.

**Biology:** The Hairy-footed Gerbil is loosely colonial though their burrows are generally widely scattered. Generally the entrance to the burrow is in the side of a sand hummock where the roots of some plant have stabilized the soil slightly.

They are nocturnal in feeding activity and omnivorous with insects forming a significant part of their diet probably throughout the year and especially during the summer months. Captive specimens of *G. gleadowi* never showed any interest in water provided to them and had a preference for various kinds of seeds though they would eat a small quantity of chopped raw vegetables. Studies in Jodhpur, India showed that *G. gleadowi* had greater salt tolerance and renal concentrating ability than *Meriones hurrianae* indicating an ability to survive on halophytic plants (Ghosh and Gaur, 1966). In the wild it is probable that *Gryllidae* (crickets) and ants are regularly eaten, as captive specimens eagerly ate any dead crickets presented to them.

Little has been recorded about the breeding habits. During the Bombay Natural History Society Mammal Survey of Kathiawar, three appeared to be the commonest litter size and young were being produced in the post-monsoon and early winter months (JBNHS Report No. 10, 1913).





Illustration 84 *Gerbillus gleadowi*: Hairy-footed Gerbil.  
(Based on captive specimens collected in November,  
15 miles east of Rahim Yar Khan, Bahawalpur Division.)

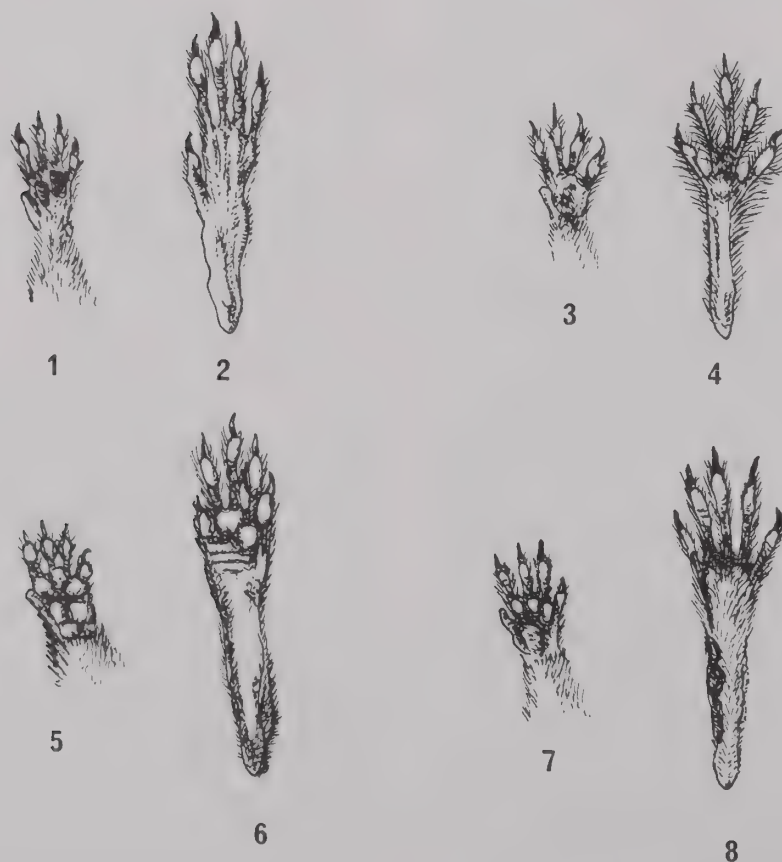


Fig. 75 Showing dorsal view of fore and hind feet.

1. Left fore-foot of *Rhombomys opimus*.
2. Left hind foot of same.
3. Left fore-foot of *Gerbillus gleadowi*.
4. Left hind foot of same. Note hair fringed digits and hairy soles.

5. Left fore-foot *Meriones persicus*.
6. Left hind foot of same. Note naked sole and light coloured claws.
7. Left fore-foot of *Meriones libycus*.
8. Left hind foot of same. Note sole hairy except for narrow border and black claws.

Litter sizes from two to five have been recorded. In the Thal Desert immature specimens were trapped in March which had probably been born the previous autumn. No pregnant females were found at that time (Taber et al., 1967). Like *G. nanus* the gestation period is believed to be about 20 days and litters are probably born mainly at two seasons, in the spring and post-monsoon or autumn season.

The Diadem Rat Snake (*Sphalerosophis diadema*) has been taken from burrows in the same region where the Hairy-footed Gerbil had been trapped near Rahimyarkhan and no doubt this species as well as the Sand Boa (*Eryx johni*) preys upon the gerbil. This nocturnal rodent is extremely agile and when frightened can leap considerable distances. They are probably also preyed upon by Desert Foxes (*V. vulpes pusilla*) which are the most conspicuous carnivora in extensive sand-dune regions favoured by this gerbil. When feeding leisurely, these gerbils are quadrupedal in gait but when frightened they progress mainly in hops, being propelled by their strong hind legs. Captive specimens could leap 61 cm (24 in.) vertically into the air as well as nearly 91.5 cm (36 in.) over the ground in one hop. In captivity they are rather delicate mammals suffering particularly from low temperatures, unless given covered shelter in which to sleep during the day.

#### GERBILLUS CHEESMANI

*Gerbillus cheesmani* Thomas, 1919; Cheesman's Gerbil.

**Description:** This is another psammophylic gerbil, adapted to burrowing in shifting sand-dunes. In external appearance it resembles *G. gleadowi* in all respects, having a pale gingery-buff or reddish-fawn pelage with pure white belly, throat and cheeks. A series of fifteen specimens from Baluchistan had the following dimensions. Head and body length averaging 97 mm (range 89–106 mm) ( $3\frac{1}{2}$ – $4\frac{1}{8}$  in.) with the tail averaging 129 mm (range 109–143 mm) ( $4\frac{1}{4}$ – $5\frac{5}{8}$  in.), the hind foot averaging 29 mm (range 26–31 mm) ( $1\frac{1}{4}$  in.) and the ear averaging 14 mm (range 13–17 mm) ( $\frac{1}{2}$ – $\frac{11}{16}$  in.). The Pakistan population therefore appears to average slightly larger in size and to have a relatively shorter tail than *G. gleadowi*. *G. cheesmani* is clearly closely similar to *G. gleadowi* except for the fact that they are allopatric populations.

**Distribution and Status:** It inhabits shifting sand-dune areas as well as mudflats in semidesert regions (see Distribution Map 107). Specimens of this gerbil collected by J. A. W. Anderson for export in 1968 were the first to be identified as *G. cheesmani* (Lay et al., 1970). It is plentiful in sand-dune regions from Nushki westwards through Dalbandin and as far as Kharan. Between Anam-Bostan and Nushki this rodent is by far the most abundant species in sand-dune areas. The University of Maryland Expedition collected specimens in 1965 for ectoparasite studies from Noa Khundi as well as 10 km ( $6\frac{1}{2}$  miles) east of Dalbandin. These specimens lodged in the Smithsonian Museum have now been identified as *G. cheesmani*. So far it has not been recorded anywhere west of the Chagai Desert basin and it has not been collected north of Nushki. These desert regions are mostly around 910 m (3000 ft) above sea level and experience fairly cold winters otherwise they are ecologically very similar to the regions of Cholistan and Thar where *G. gleadowi* occurs west of the Indus river.

In Iran it has only been collected in two separate localities

in the extreme west and again in eastern Iran (Lay, 1967). It has now been collected in southern Afghanistan around Girishk and Kandahar (Hassinger 1968). Westwards it is found throughout southern Iraq and Arabia (D. L. Harrison, 1972).

Its occurrence in Pakistan apparently constitutes the eastern extremity of its range and as it inhabits barren sparsely populated regions it is of no economic importance.

**Biology:** It is a nocturnal rodent and colonial in burrowing habits. Their burrow entrances are frequently surprisingly large and wide and they are never plugged up during the day. Though not occurring in dense or large burrow colonies or associations they are gregarious in Baluchistan and generally two or three burrow systems are located in the same vicinity.

Nothing has been recorded about their feeding habits but they appear to be partly graminivorous and herbivorous. It is not known whether they eat insects as well.

J. A. W. Anderson collected two lactating females on 15 February and after excavation of their burrows found two litters of eight (in lit., 1968). Another captive pair from Baluchistan produced litters of five and six in the laboratory (Lay et al., 1970). I have trapped newly weaned juveniles on 2 November which could not have been more than about one month old. Probably breeding takes place throughout the year, with the majority of litters being produced in the spring and summer months.

It is noteworthy that both in Baluchistan and Iran this gerbil has been trapped in the same areas as *G. nanus*, though the latter only burrows in gravelly soils or areas of firmer substrate. Nothing is definitely known about the predators of this gerbil though it lives in regions where there are foxes (*Vulpes cana* and *V. vulpes*), owls (*Athene noctua*) and snakes (*Eristicophis mcmaboni* and *Sphalerosophis arenarius*) all of which are known to feed on rodents (Minton, 1966).

#### Genus TATERA Latase, 1882

The genus consists of ratlike rodents with naked soles to the hind feet and fairly long well-furred tails. All of them are gregarious in habits and nocturnal.

Though closely allied to the Gerbillines (genus *Gerbillus*) and Jirds (genus *Meriones*), it is generally considered to be primitive phylogenetically and less specialized. There are about 25 species mostly inhabiting the African subcontinent. Only one species *Tatera indica* has spread throughout the Middle East, the Indo-Pakistan subcontinent and Ceylon.

#### Key to the Genus and Pakistan Species of TATERA

Large size. Head and body 143–180 mm. Tail well furred and with terminal tuft of blackish-brown hairs and having dorsal and ventral surfaces dark brown with sides of tail paler buff. Soles of hind feet naked. Tympanic bullae relatively small, less than 25 per cent of occipito-nasal length. Upper incisors are longitudinally grooved and cheek teeth are moderately cuspidate in young specimens.

... *Tatera indica*

#### TATERA INDICA

*Tatera indica* Hardwicke, 1807; The Indian Gerbil or Antelope Rat (see Illustration 85).

**Description:** This is quite a large rodent, adult males being equal in size to *Rattus rattus* but with a comparatively





Illustration 85 *Tatera indica*: Indian Gerbil or Antelope Rat. (Based on captive specimens adult male from Khanewal, Punjab.)

larger head and longer tail. *Tatera indica* is for example considerably bigger than *M. hurrianae*.

The body fur is long and silky, hugging the body contours, and is generally reddish-fawn or biscuit coloured with a clear white abdomen, throat and inside of limbs. The ears are sparsely haired and quite prominent and upstanding. Even when seen in the field the larger naked ears serve to distinguish this gerbil from *Meriones* species. The eyes are black and large in this nocturnal animal. The upper incisors are rather slender in comparison to its size. They curve backwards, are coated with yellow enamel and bear a distinct longitudinal groove. Examination of the skull of this species reveals that the tympanic bullae are not greatly inflated in contrast to the Gerbillines. The nasal bones are very elongated extending well in front of the upper incisors. The grinding teeth show traces of cusps and in the upper tooth row have conspicuous outer folds of dentine. The inner sides of these teeth have much smaller narrower folds. The hind foot is strongly developed and this rodent normally progresses by hopping, and regularly sits up on its hind feet whilst foraging. The hair on the upper part of the hind foot is white, and as already indicated the sole is naked. The three middle toes are markedly longer than the outer pair on the hind feet. The fore-feet have four normally-developed digits with a vestigial thumb which bears a claw. These claws are normally blackish in colour.

The tail is the most reliable identifying character for this species, being distinctively coloured. Both the dorsal and the ventral surfaces are dark greyish-buff with the sides of the tail a paler creamy-buff. None of the *Meriones* species have this tail pattern. The distal one-third of the tail bears

a dorsal crest of longish black hairs terminating in a tuft. Generally the tail is about 120 per cent of the head and body length being comparatively longer than *Meriones* species but shorter than *Gerbillus* species.

There is considerable variation in the size of specimens from Pakistan. Generally males are heavier and average between 150–227g ( $5\frac{1}{4}$ –8oz) with the females averaging between 100–180g ( $3\frac{1}{2}$ –6 $\frac{1}{3}$ oz). Average head and body length of 13 specimens from different parts of Pakistan was 164mm ( $6\frac{7}{16}$ in.) (range 143–188mm) with the average tail length 179mm (range 152–196mm) ( $7\frac{7}{16}$ in.) and the hind feet averaging 37mm (range 34–40mm) ( $1\frac{7}{16}$ in.) and the ear length averaging 24mm (range 21–31mm). Females have eight mammae. The population inhabiting extreme south west Baluchistan (Chagai) comprised very large individuals with males measuring up to 188mm head and body length, and tail length 205mm.

**Distribution and Status:** Compared with all other Field Rats and desert dwelling rodents this appears to be the most ecologically adaptable species. It will not usually be found in very extensive sand-dune tracts, nor in high mountainous areas, otherwise it seems able to adapt to almost any kind of soil and even rocky areas. It is most generally associated with cultivated tracts. But it does occur in extensive desert regions and low mountainous areas as well as throughout the alluvial plains. It often shows a preference for village sites and evinces commensal tendencies as well.

It is found throughout the irrigated canal colonies of the Punjab and in some villages it has become commensal, with its aggressive habits replacing *Rattus rattus*. Relict populations



Distribution Map 108 Indian Gerbil or Antelope Rat.

are found in the grain depots in the heart of Karachi city, e.g. Thole produce yard. Although it is absent from the mountainous parts of Baluchistan it has extended across the Mekran and up into the Chagai plateau, as well as across the Indus as far as Mach and Pishin. Around Noa Khundi in extreme south west Baluchistan this rodent occurs in very barren uncultivated regions but in association with villages. It is found throughout the vale of Peshawar and Bannu. It is absent from the Murree foothills, but I have trapped it at 2300ft in the Margalla Hills.

Extra-liminally, it has extended throughout the dryer regions of India including the Deccan Plateau and throughout Ceylon (Phillips, 1923). It has spread into Afghanistan and has been collected around Herat, Jalalabad, Kandahar and Girishk (Hassinger, 1968) and Laghman (Niethammer, in lit.). In Iran it is found mainly in the southern provinces (Lay, 1967) and it has successfully spread westwards into Iraq and Syria (Vesey-Fitzgerald, 1953). It has not been recorded in the USSR, indicating that high mountains are a barrier to the spread of this most adaptable oriental species.

This gerbil undoubtedly does damage in destroying food grains though surprisingly it does not seem ever to have multiplied to plague proportions in Pakistan as have other field rats (Wagle, 1927). In my own experience, sweet potato crops have been largely destroyed by this rodent. Prater records that they also store large quantities of grain in their underground burrows. Altogether it is probably the second most serious economic rodent pest (after *Rattus rattus*) from the viewpoint of agricultural crop damage and food grain losses in Pakistan.

**Biology:** Being one of the most abundant rodents in the dryer regions of India as well as Pakistan, there have been a number of detailed studies of this Antelope Rat (Prashad, 1954; Prakash, 1959; and Jain, 1970).

It is gregarious, living in loose associations or colonies. However in contrast to *M. burrianae* they are aggressive rodents and individuals live in a separate burrow, neither will

they tolerate the presence of any other species in their burrow systems. Typically these burrows are excavated in embankments or hillocks which have built up around bushes. Such burrows usually have two or three separate exits with one or two side passages terminating just beneath the surface, which are believed to act as emergency escape tunnels, and the main tunnel consists of a long winding passage which descends to a depth of 1.30–1.50m (4½–5ft) below the surface and contains an enlarged nest chamber lined with chopped dried vegetable material. The burrow mouth is 102–153mm (4–6in.) in diameter and often located around or beneath the roots of bushes (Vesey-Fitzgerald, 1953; Prater, 1965; and Prakash, 1962). I have also trapped this rodent in the vicinity of wood piles inside house compounds, and even in garages of houses in Lahore city. It has also been found burrowing in the mud walls of occupied houses. This species often excavates short simple burrows in crop land and these are probably used as bolt holes, their more permanent burrow systems being located on the edge of cultivation in less disturbed regions. Their burrow systems can be found in areas remote from cultivation, however, but probably never very far from river systems or irrigation canals. Dr. Taber (1967) was of the view that the spread of irrigated cultivation has led to an enormous increase of numbers and spread of this species throughout the Punjab region of Pakistan.

Studies on the food habits of *T. indica* reveal that it is quite omnivorous and that insects contribute a more significant proportion to the diet than that of most other rodents in the region. Studies in south India showed that seeds predominated in the diet in mid winter. Green food in the form of leaves and stems were more significant in the post monsoon season but throughout the year never declined below 10–15 per cent of the diet, and Petter (1961A) showed that it cannot survive without fresh green food. They also ate cutworms and beetle larvae (Prashad, 1954A and 1954B). Studies in Rajasthan (India) indicated that insects formed a higher proportion of the diet in these north western desert regions. In September and October, after the monsoon, as much as 40 per cent of the stomach contents comprised insect food. Seeds comprised 40 per cent of the diet in January but were entirely absent from the food in July and increased to 10 per cent in August and September. In the spring, young leaves and flowers of various forbes formed up to 20–30 per cent of the diet whilst insects increased from 10 per cent in March to 20 per cent in April and 30 per cent in May (Prakash, 1959A). These aggressive rodents evince cannibalistic tendencies and it is believed that young individuals when they first leave the maternal burrow suffer intraspecific predation particularly during peak breeding periods such as September and October. Females in captivity commonly eat their young (Prashad, 1954B). I have observed that if two males are placed together in the same cage they at once start fighting, striking out with their fore-paws and uttering shrill chattering squeaks.

*Tatera indica* is very prolific and young may be born at all seasons of the year, but there is a tendency towards increased breeding activity in the spring and monsoon season. Studies in Rajasthan indicated that the average adult female produces 17.72 young, annually and that litter sizes varied from one to nine with the majority of litters comprising four or five individuals (Jain, 1970). R. Prashad recorded litter sizes from five to eight in south India with a lull in breeding activity in mid summer. In the colder north western region of Pakistan, however, there is a lull in breeding activity from September to January and the greatest number of



pregnant females were trapped in March, April and September, (Taber et al., 1967). A. P. Jain also recorded regression in male testes from September to January in Rajasthan (Jain, 1970). Female gerbils reach sexual maturity when 10–12 weeks old, and when their body weight reaches 70–75g ( $2\frac{1}{2}$ – $2\frac{3}{4}$ oz), males become fecund when 12–14 weeks old and have a body weight of 105–110g ( $3\frac{3}{4}$ – $3\frac{7}{8}$ oz). A captive female from Khanewal gave birth to four young on 17 March and a second litter of six young on 9 April, i.e. 23 days after the first litter. E. Walker (1964) records 22 days gestation period for the African species, *Tatera afra*. The young are blind, naked and pink at birth and in the case of the Khanewal captive female the young could squeak audibly within 24 hours of birth. By 11 days of age they were still blind and had a fine coat of silky grey hairs, by 14 days their eyes opened and they were beginning to venture from the nest. By 21 days they were fully weaned and independent.

Because of their numerical abundance these gerbils can do considerable damage to agricultural crops. They particularly seem to relish seeds of leguminous crops.

Remains of *T. indica* have been found in the stomach of *Felis chaus*, and *Herpestes edwardsi* (Prakash, 1959A). No doubt they form an important food source for most of the small carnivora in Pakistan and foxes have been observed by me at night apparently hunting in *T. indica* colonies. Rat Snakes (*Sphalerosophis*) as well as cobras (*Naja naja*) are large enough to swallow this rodent and are certainly found commonly in regions where *T. indica* is also abundant such as the East Nara.

*T. indica* lives and feeds within a relatively restricted range. In Rajasthan this was found to average 1912.5m (6270ft) for females and 1875m (6150ft) for males (Prakash and Rana, 1970). Trapping studies reveal that there is roughly a 50:50 sex ratio of *T. indica* except during the autumn when there is a high incidence of mortality amongst young males, thought to be due to intraspecific competition (Jain, 1970).

#### Genus MERIONES Illiger, 1811

Ellerman and Morrison-Scott in their checklist (1951) recognized 13 species. E. Walker (1964) recognizes 12 species. Generally referred to as Sand Rats or Jirds, they have a combined range from North Africa through the Middle East, Asiatic Russia, Mongolia and China and extending southwards to the dry north western part of the Indo-Pakistan sub-continent.

They are ratlike in form but the tail is well covered with hairs throughout its length and bearing a crest of longer darker hairs along its dorsal surface in the distal portion. The hind foot is generally not greatly developed and they are relatively thickset rodents and not so agile as *Gerbillus* species. Most tend to be colonial and they favour semidesert regions including steppe mountain areas, alluvial plains, cultivated valleys and arid saline flats. Generally the tail is approximately equal to the head and body length whereas in the smaller sized *Gerbillus* genus the tail is considerably longer.

#### Key to the Pakistan Species of MERIONES

Relatively robust ratlike rodents (head and body length 114–170mm) with hairy tails terminating in a tuft of darker hairs. Ears relatively small and hair covered. Upper incisors longitudinally grooved and cheek teeth, never cuspidate and having prismatic grinding surfaces (see Fig. 68). Tails never dark ventrally or pale along sides.

(i) With sole of hind foot naked. Belly fur a dirty creamish-white. Ears relatively small 10–12mm long. Claws blackish. Tympanic bullae less than 33 per cent of occipito-nasal length.

... *Meriones burrianae*

(ii) Sole of hind foot naked. Belly fur pure white. Ears relatively large 21–24mm long. Claws brownish or horn coloured, never black. Tail with thick and luxuriant terminal tuft. Tympanic bullae less than 31 per cent of occipito-nasal length.

... *Meriones persicus*

(iii) Soles of hind foot hairy except for small heel patch. Belly fur pure white. Ears medium size 16–22mm. Claws black. Tail with conspicuous black terminal tuft and usually equal to or slightly longer than head and body length. Tympanic bullae 34 per cent of occipito-nasal length.

... *Meriones libycus*

(iv) Soles of hind feet hairy except for small heel patch. Claws brown or horn coloured, not black. Tail usually 80 to 90 per cent of head and body length and with poorly developed terminal tuft. Tympanic bullae enlarged, usually 38 per cent of occipito-nasal length.

... *Meriones crassus*

#### MERIONES PERSICUS

*Meriones persicus* Blanford, 1875; Persian Jird.

**Description:** The Persian Jird can readily be separated from other *Meriones* species occurring in Pakistan by the hairless soles of its hind foot (see Fig. 75) and the bushy tip to its tail which is particularly prominent in this species extending over the distal one-third to one-half of its tail. These long hairs are generally dark brown often mixed with a few white hairs. The proximal portion of the tail besides being thick and well furred is bi-coloured, being creamy-white on its ventral surface.

The Persian Jird also has comparatively longer ears than other species occurring in Pakistan. Average ear length of six specimens from Baluchistan was 23mm ( $\frac{7}{8}$ in.).

The body fur is a sandy-buff colour with a sprinkling of black-tipped hairs. The belly fur is clear white. The claws on the hind feet are whitish or pale horn coloured and this is an important factor in distinguishing the Persian Jird from *M. libycus* which occurs in the same region. A series of 18 specimens from various parts of Baluchistan had the following measurements. Average head and body length 143mm (range 130–168mm) with the tail averaging 160mm (range 145–180mm), the hind foot averaging 38mm (range 35–41mm) and the ear averaging 23mm (range 21–26mm). An adult male from Ziarat weighed 100g ( $3\frac{1}{2}$ oz) and its longest vibrissae measured 65mm ( $2\frac{1}{2}$ in.).

**Distribution and Status:** The Persian Jird seems to occur throughout the mountainous regions of Baluchistan avoiding the broader valleys and lower altitudes where it is replaced by *M. libycus*. It will be found in steep rocky areas as well as in small patches of cultivation.

The Persian Jird has been collected in the Mekran as far south as the sea coast. It has been collected around Ormara, Kalat State in the Gishk and Chiltan mountains and in the higher mountain ranges north east of Quetta including Kaliphat and Zarghun. This Jird has not yet been collected from north Waziristan or the Kurram agency. It has been collected



*Meriones persicus* Known distribution  
Probable range  
*Meriones hurrianæ* Known distribution  
Probable range

Distribution Map 109 Persian Jird.  
Indian Desert Jird.

as high as 3250m (11,000ft) on Mount Kaliphat and as low as 1850m (6000ft) around Kalat.

Extra-limally, it occurs in Afghanistan where it has been collected around Kabul, Jalalabad and also around Herat in the east (Niethammer, 1965). It was collected around Kandahar (Hassinger, 1968). It occurs throughout most of the higher regions of Iran except in the Caspian forests (Lay, 1967). To the north it occurs in Russia through Trans-Caucasia and south western Turkestan (Flint et al., 1965).

**Biology:** The Persian Jird is ecologically rather distinct from the other species inhabiting Pakistan on account of two factors. It is nocturnal in feeding activity, and it is not so highly gregarious, tending to live in rather dispersed colonies. Associated with higher mountainous areas in Baluchistan, they often make use of natural crevices between rocks and do not excavate such extensive burrow systems as many of the other Jird species. A favourite biotope is amongst the dry stone embankments on the borders of upland terraces of cultivation. When it does excavate a burrow in open soil, this is generally quite short extending for hardly more than 1m (3¼ft) below the surface. Burrow systems may have more than one entrance but do not develop into the complicated labyrinth of interconnecting burrows such as may be encountered in colonies of *M. libycus* or *M. hurrianæ*.

They appear to be fairly omnivorous in feeding habits, subsisting on grass roots, stems and seeds when available. They will also eat insects and with their nocturnal feeding habits, larger ears and more aggressive habits they seem ecologically closer to *Tatera indica* than the other Jird species. It is believed that the gestation period is about 28 days. Burrows have been excavated in Baluchistan in April containing small young. Litters are born in an underground nest chamber which is lined with soft grasses. There is no information as to average litter sizes. Two captive born litters, each of only two, produced in Khanewal were

pink, blind and hairless at birth. They had a fine covering of dark hairs by the eighth day but their eyes did not open until the fifteenth or sixteenth day. Weaning takes place between 18–20 days from birth. It is probable that breeding is confined to the spring or early summer months since food supplies are scarce in winter at the elevations inhabited by this Jird.

Available evidence indicates that this Jird does not hibernate in winter but it may undergo periods of torpidity during which it does not emerge above the ground. There is evidence, however, that specimens will emerge above ground and forage for short periods during December and January. J. A. W. Anderson trapped it near Wam at 2150m (7000ft) elevation in December. Probably this species carries grains and seeds to its underground burrows for storage and consumption during the winter, as this habit has been observed for *M. libycus* living in adjacent regions.

The Stone Marten (*Martes foina*) and the Hill Fox (*Vulpes griffithi*) are the main predators on this Jird. Young individuals may be taken by the Pallid Scops Owl (*Otus brucei*) which is abundant in the same biotope in Baluchistan. Dr. Niethammer found remains of *M. persicus* in owl pellets from Afghanistan (Niethammer, 1965).

*M. persicus* is commonly trapped along with *Calomyscus bailwardi* and the two species coexist in the same kind of habitat: it appears that the smaller *Calomyscus* actually uses burrows excavated by *M. persicus*.

Captive specimens exhibit quite aggressive behaviour and individuals have to be kept separate. Cannibalism has been recorded with this Jird in captivity, males killing and eating young (J. A. W. Anderson, pers. comm.).

## MERIONES HURRIANAE

*Meriones hurrianæ* Jerdon, 1867; Indian Desert Jird, also known as the Indian Desert Gerbil (see Illustration 86).

**Description:** This Jird has noticeably small ears. The tail is generally slightly shorter than the head and body length and the distal one-third bears a dorsal crest of longer black hairs which terminate in a pencil tuft. The body fur is a sandy greyish-buff colour with a sprinkling of black tipped hairs. Its fur is quite short, 6–7mm (¼–⅝ in.) in length and not so soft or so long as the body fur of *M. persicus*. The ventral fur instead of being pure white has a greyish or creamy colour, the distal tips of the hairs being light fulvous-brown. The soles of the hind feet are hairy with a restricted naked patch around the region of the heel. The claws tend to be dark brown or blackish and are noticeably longer in this species as compared with the claws of *M. persicus* or *M. libycus*.

A typical adult male specimen from Khanewal weighed 70g (2½oz). Females are generally lighter in weight and slightly smaller. Average size of 16 specimens from different regions of Pakistan were as follows. Head and body length averaging 125mm (range 115–143mm) with the tail averaging 132mm (range 100–151mm) and the hind feet averaging 30mm (range 27–36mm). The average ear length is 11mm (range 10–14mm). As in all the Jirds their upper incisors bear longitudinal grooves and are coated with orange enamel.

This species can most easily be separated from other Jirds by the relatively shorter ears, yellowish-grey belly fur coupled with comparatively short coarse greyish-buff dorsal fur.

**Distribution and Status:** It is found throughout the alluvial plain of the Indus favouring the edges of cultivation



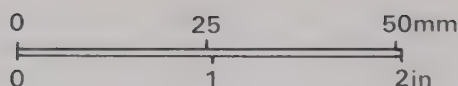


Illustration 86 *Meriones hurrianae*: Indian Desert Jird.  
(Based on captive specimens collected 15 miles east of  
Rahim Yar Khan, Bahawalpur Division.)

and avoiding very extensive sand-dune areas. It does not occur in rocky areas and seems to need fairly firm soil for burrowing. Its burrows will not be found within well cultivated irrigated tracts but always in waste areas and non-cultivated patches such as roadsides, canal embankments and sandhills.

*M. hurrianae* is the most numerous rodent in the sand-dune areas in the sea coast around Karachi and it has extended westwards into the Mekran. Absent from the mountainous interior of Baluchistan or the Salt Range it is probably the most numerically abundant rodent in the Indus Plain. It extends into extensive desert regions provided they are not dominated by shifting sand-dunes. It is not found in the rockier part of the Salt Range nor the Himalayan foothills but has spread eastwards to Mardan and Peshawar in the north.

Despite their numerical abundance they are not serious crop pests as they prefer uncultivated tracts. However at certain seasons they will cut green leaves and stems from growing crops and take this material into their burrow as food stores. Earlier investigations upon pest rats in Sind indicated that this species was comparatively unimportant economically (Wagle, 1927). It is certainly one of the most abundant rodents in relict patches of tropical thorn scrub or uncultivated land throughout the Indus plain.

Outside of Pakistan this Jird is mainly confined to Kutch and the Rajasthan Desert in India. It also has spread to the northern regions of Gujrat. It has spread westwards along the Mekran coast as far as Bunder Abbas. There are no specimens or reports of this species from Afghanistan, or Iran.

**Biology:** *M. hurrianae* is so widespread and numerically abundant in the cultivated tracts of Pakistan and adjacent Indian territories that it has been extensively studied and a good deal is known about its food habits and breeding biology. (Prakash and Ishwar, 1962 and Prakash, 1964; Prakash et al., 1965.)

It is a relatively unaggressive rodent with gregarious habits, occurring in colonies with burrows situated in close proximity to each other. They particularly favour embankments and the edges of hillocks or mounds for burrowing. Where they are numerous their burrows literally honey-comb such embankments. They are diurnal in feeding activity being most active in the early morning and late afternoon. In the middle of winter they do not emerge to feed early in the morning, but wait until the sun is warmer and they may be observed above ground throughout the day at this season. (Prakash and Kumbkarni, 1962.)

Extensive studies have shown that this jird feeds mainly on seeds in December and January. Seeds of various wild herbs and bushes may comprise up to 60 per cent of the diet. By May the proportion drops to 20 per cent. All sorts of insects are eaten, particularly orthopterous, but they are much less dependent on insects than *Tatera indica* (Prakash, 1959A). In Rajasthan 5 per cent of the food intake comprises insects in April, 15 per cent in May, June and July and 10 per cent in August and September (Prakash, 1959A and 1968). Throughout the year leaves, stems and grass roots form an important part of the diet increasing to 60 per cent during July, August and September and falling to about 35 per cent in winter. In irrigated forest plantations in the southern Punjab I have observed that this jird feeds largely on the fallen seeds of

*Acacia arabica* and *Prosopis glandulosa* during December and January. In May I have observed it pulling the flowering heads of *Calotropis procera* into its burrows. In captivity they will readily eat grasshoppers and also drink water, though in the wild state they probably have to subsist on the water available in succulent vegetation (McCann, 1927).

The burrow systems can be very extensive extending in fairly straight tunnels at a depth of about 53.4cm (21in.) below the surface for up to 2m (6½ft) (Wagle, 1927 and Agrawal, 1965). Usually there are from three, up to as many as 15 entrances and these are never closed up with loose soil. Several individuals can be observed using the same burrow entrances, but it is probable that they occupy separate underground chambers when at rest. In contrast to *Tatera indica*, these rest chambers are never lined with nesting material. Their feeding territory seems to be within a radius of about 20m only from the burrow (McCann, 1927), with a maximum range of 150m (Fitzwater and Prakash, 1969). Studies in Rajasthan showed a population density of Desert Jirds of 477 per hectare. Each individual consumed a total of 6g (0.2oz) of vegetable matter daily (Prakash, 1968).

The Desert Jird can breed throughout the year but there seem to be two peak periods when litter sizes are larger and a higher proportion of females are pregnant or lactating. These are during February, March and again in July and August (Prakash, 1964). Average litter size is three to five, although up to nine young have been recorded, and females produce three to four litters per year, (Prakash, 1960). The gestation period varies from 28 to 30 days and the young are born naked and blind. Their eyes open on the fifteenth or sixteenth day and they are weaned at about three weeks of age. Observation on captive females show that they are in oestrus condition immediately after parturition (Prakash, 1964).

It appears to be a relatively silent rodent and C. McCann (1927) records that even when held up by the tail it only emits a faint squeaking. This jird will give warning of approaching danger by drumming rapidly on the ground with its hind feet. I have heard this sound even from animals which are completely concealed inside their burrows, when it was audible for a distance of 4.5m (15ft). It can obtain food throughout the year, and shows no evidence of undergoing even short periods of inactivity or torpidity, but at certain times they do store seeds and other collected vegetable matter in their underground burrows, contrary to what has been observed of the population in Rajasthan, India, (Prakash, 1962). Near Rahimyarkhan, in early February I have observed this jird cutting and carrying young wheat into its burrows.

Being so widespread and abundant in the Indus plain the Desert Jird is an important source of food for all the commoner carnivores. The Desert Fox (*V. vulpes pusilla*) and the Jungle Cat (*Felis chaus*) have both been observed hunting this species, and the remains of this jird has been found in the stomach of *V. vulpes* shot near Khanewal. Tracks of large snakes are often seen around colonies of this jird and the Rat Snake (*Sphalerosophis atriceps*) which is widespread in the Punjab, has been found in a burrow excavated by *M. hurrianae*, being undoubtedly attracted by the rodent food supply. Being diurnal it also occasionally falls prey to raptors such as the White-eyed Buzzard (*Butastur teesa*).

*M. hurrianae* is often found in the same region as *Tatera indica* but always in separate colonies well away from the aggressive *T. indica*. *Gerbillus nanus* has also been trapped in the same biotope.

## MERIONES LIBYCUS

*Meriones libycus* Lichtenstein, 1823; The Libyan Jird.

**Taxonomy:** Some Russian authors treat *Meriones erythrourus* as a separate species (Sokolov et. al., 1963) but recent Russian zoological publications (Bobrinskii et al., 1965) indicate that it is now considered as conspecific with *M. libycus*, and D. L. Harrison (1972) treats *erythrourus* as an eastern greyish-coloured race *M. libycus erythrourus*. Ellerman and Morrison-Scot (1951) also considered it as a subspecies of *M. libycus*.

**Description:** Closely similar to *M. persicus* and occurring in approximately the same areas, it can be distinguished from the latter species by relatively smaller ears and a less bushy terminal tail tuft, also the hind feet have hairy soles (see Fig. 75) and the claws are black or very dark brown. This at once separates it from *M. persicus*. The body fur is long and silky, with the hairs averaging 13–15mm in the dorsal area and of a yellowish-grey or sandy colour with a sprinkling of black-tipped hairs. The hair on the ventral surface is pure white and the terminal tail tuft is generally blacker than that of *M. persicus* or *M. hurrianae* with the longer dark hairs extending in a dorsal crest for the distal one-third of the tail. The ventral surface of the tail is ochraceous as compared with *M. persicus*, which has the ventral tail surface creamy white. As with all the jirds the ears are well covered with hairs on both surfaces and the upper incisors are grooved and covered with orange enamel.

An adult male collected from Singit Bagh, Mastung in northern Kalat weighed 90g (3¼oz) and had testes 23mm (¾in.) long in late October. Twenty-one adult specimens from various parts of Baluchistan had the following average measurements: head and body 133mm (range 115–168mm); tail 137mm (range 125–162mm); hind foot 35mm (range 30–38mm). Average ear length 18mm (range 17–22mm).

**Distribution and Status:** *M. libycus*, though inhabiting upland mountainous regions in Pakistan, is confined to the valleys and low-lying areas, and it avoids steep mountain slopes or rocky regions at higher elevations where it is replaced by *M. persicus*. It is found from sea level on the Mekran coast up to about 1680m (5500ft) and is typically associated with tamarisk studded sandy flood plains in Baluchistan and the edges of cultivation in the broader valleys.

*M. libycus* has been collected from most parts of Baluchistan in the lowland areas. It has been collected throughout Kharan and Kalat, around Dalbandin and Nushki and around Quetta and up to Chaman. It seems to be rare in the northern mountainous parts of Baluchistan. It has been collected in south Waziristan. It does not extend anywhere eastwards as far as the Indus River and has not been recorded north of Waziristan.

Extra-limally it is widely distributed from North Africa through Egypt, Arabia. Israel and Iran.

Due to its diurnal and colonial habits it has been well known from Afghanistan around Kandahar as early as 1842. It has been collected from around Kabul, Ab-i-Istada as well as Herat (Niethammer, 1965). In Iran it has been collected in every province except the forested slopes of the Elburz Mountains and the Caspian coastal plain (Lay, 1967). Northwards it extends throughout Russian Turkestan up to the Aral Sea and eastwards to Chinese Turkestan (Flint et al., 1965).





Distribution Map 110 Libyan Jird.

Since this jird frequently lives in colonies bordering on cultivation and may reach a high population density in such regions it is occasionally harmful to various agricultural crops. I have observed in March that it sometimes does considerable damage cropping young green wheat and lucerne particularly around the edges of such field crops.

**Biology:** Some information has been recorded about the habits of the Arabian population of this species (Vesey-Fitzgerald, 1953 and Lewis et al., 1965), and it appears to be more closely similar to *M. hurrianae* than *M. persicus*. They have the same habit as the latter species of giving an alarm call by drumming rapidly on the ground with their hind feet, and characteristically do this whilst sitting just inside the safety of their burrow entrances. When out foraging they race across open pieces of ground with their tails raised vertically above their backs until they reach the shelter of the next shrub. Like *M. hurrianae* they are gregarious and live in extensive colonies where their burrows are located in comparative close proximity. This species does not seal the entrance of its burrow and like *M. hurrianae* frequently excavates in the firmer soil around the roots of a Tamarisk bush. Such burrow systems appear to be extensive and may have two or more entrances and they will literally honeycomb embankments where colonies occur. Observations on captive specimens indicate that it is a relatively placid rodent and not as aggressive as *M. persicus*. They are diurnal in feeding activity and are often quite bold in the presence of humans. They can readily be observed actively feeding above ground in the early morning and evening and in winter even in the middle of the day. At Anam Bostan I have been able to approach within five or six feet of many individuals whilst they were actively foraging.

Little has been recorded about the feeding habits of this jird but I have seen them feeding on various unidentified grass seeds and fruits of succulent *Chenopodiaceae* and the leaves of *Lycium barbatrum*. They will also dig up and eat bulbs of *Allium*, *Scilla* and *Tulipa* species which grow in the

regions of Baluchistan where it occurs. In cultivation they often do considerable damage to tomato and potato crops. They have also been reported as damaging lucerne crops in Arabia (Cheesman and Hinton, 1924).

*M. libycus* probably confines its breeding activity to the spring, and autumn months when food is more readily available. Average litter size appears to be three or four. A pregnant female with four embryos was trapped on 26 October in Iran (Lay, 1967).

Because of the harsh climate and periods of food scarcity with which this rodent has to cope in Baluchistan it is believed that in winter it does undergo periods of torpor when it remains underground in a relatively inactive state. Excavation of their burrows reveals that they definitely carry grains and seeds to their underground chambers and such stores are probably saved for winter consumption. During the coldest part of winter they very seldom emerge above ground. There is no evidence that they undergo true hibernation.

*M. libycus* appears to be the principal food prey of the Marbled Pole Cat (*Vormela peregusna*) and the latter is often found living inside the burrows of *M. libycus*. Being diurnal they are probably preyed upon by raptors such as the Booted Eagle (*Hieraaëtus pennatus*) and the Long-legged Buzzard (*Buteo rufinus*) both of which are not uncommon in Baluchistan. The latter species is a winter visitor but I have watched it hunting over tracts inhabited by this jird. *M. libycus* has been trapped in Iran in the same burrow system with *Rhombomys opimus* (Lay, 1967). It is abundant around Nushki in Baluchistan and shares the same biotope with *R. opimus* and *Gerbillus cheesmani* in this region. It has been trapped around Quetta in the same biotope as *Cricetulus migratorius* though the latter certainly lives in separate burrows.

## MERIONES CRASSUS

*Meriones crassus* Sundevall, 1842; Sundevall's Jird also known as Swinhoe's Jird.

Subspecies *Meriones crassus zarudnyi* (Ellerman and Morrison-Scott treat this as a subspecies in their checklist, but all recent Russian publications (Flint et al., 1965 and Bobrinskii et al., 1965) indicate that *M. zarudnyi* is a distinct species which does not occur in Pakistan).

**Description:** This jird is closely similar to *M. libycus* in external appearance but can be separated from the latter by examination of the tail, which is whitish on its ventral surface, plus the hind feet which have pale horn coloured claws with the sole of the feet covered with fine white hairs except for a small bare patch on the heel. The hind feet average about 26mm (1in.) in specimens from Baluchistan compared with 35mm (1½in.) for *M. libycus*. The tail is invariably slightly shorter than the head and body length and the terminal tuft of longer black hairs is usually rather skimpy and never as bushy as that of *M. libycus*. Also the black hairs do not extend in a very noticeable dorsal crest along the distal part of the tail. The body fur is sandy-buff with a mixture of black-tipped hairs and the hair on the ventral surface is white. With its shorter tail it is on average a smaller jird than *M. libycus* and is considerably smaller than *M. persicus*. A series of 24 specimens from different parts of Baluchistan and Waziristan had the following average dimensions: head and body 114mm (range 102–125mm); tail 97mm (range 78–114mm); hind foot 27mm

(range 24–29mm); and ear 16mm (range 13–21mm). Eight adult specimens varied from 29–40g (average 35.25g) body weight.

**Distribution and Status:** This jird has not been recorded in the vicinity of cultivation in Pakistan and it seems to favour the most barren stony plains. In Waziristan it has been collected in wide sandy valleys as well as on gravelly escarpments.

The first records for this jird in Pakistan is of specimens collected in Wana in south Waziristan. It appears to be fairly widespread in the broader stony valleys of Baluchistan and extending right down to the Mekran coastal area. Specimens have been collected from around Loralai, Nushki, Kharan, Khuzdar, Dalbandin, Noa Khundi, Panjgur and Parom.



Distribution Map 111 Sundevall's Jird.

Outside of Pakistan it is confined to the south eastern part of Afghanistan in the Seistan Desert basin. It has been collected around Kandahar and Girishk (Hassinger, 1968). In Iran it has been collected throughout the Khuzistan plain and south along the Persian Gulf coastal plain (Lay, 1967). It also extends across North Africa from the Sudan, Egypt, Libya and Algeria.

It certainly appears to be less common than the other two *Meriones* species inhabiting the upland regions of Baluchistan and Waziristan. Inhabiting the more barren gravelly tracts it is of no economic importance.

**Biology:** Unlike *M. libycus* this sand rat is almost entirely nocturnal in feeding activity. It is colonial in its burrowing but in Pakistan it never occurs in such large or extensive colonies as *M. libycus* probably because it inhabits more desolate regions with a poorer food supply. In Aden it has been recorded as feeding on locusts (*Schistocerca* spp.) (Vesey-Fitzgerald, 1953). It is however thought to be herbivorous, and mainly graminivorous feeding on seeds. In Iran it was found feeding on the seeds of *Peganum bormala* and

caches of these seeds were also found in their underground burrows (Lay, 1967). In Saudi Arabia they were observed feeding on thistle seeds and donkey melons (*Citrullus* sp.) (D. L. Harrison, 1972). They regularly store seeds in their underground burrows like *M. libycus*.

Little has been recorded about the breeding of this species. In Baluchistan but presumably litters are produced mainly from the spring to late summer months as in Arabia (Lewis et al., 1965). Dr. Lay trapped young animals in mid November in Iran, and Dr. Harrison noted rapid and prolific reproduction throughout the spring and summer months in Arabia (Harrison, 1972). The gestation period in captivity is 22 to 24 days (Misonne, 1959) with litters of up to seven being recorded.

*M. crassus* occupies the same biotope as *Gerbillus cheesmani*, *Jaculus blanfordi*, and *Meriones libycus*.

## Genus RHOMBOMYS Wagner, 1841

### Key to the Genus and Pakistan Species of RHOMBOMYS

Very large robust ratlike rodents. Males up to 185mm head and body length. Ears small and hairy (13–17mm long). Tail thick, hair covered and terminating in bushy tuft of dark brown hairs. Claws black. Upper incisors with two longitudinal grooves and cheek teeth rootless and continuously growing (see Fig. 68).

... *Rhombomys opimus*

### RHOMBOMYS OPIMUS

*Rhombomys opimus* Lichtenstein, 1823; Great Gerbil, or Giant Day Jird (see Illustration 87).

This is a monotypic genus and the species was first described from Russian Turkistan and Mongolia. It differs from the *Meriones* species in two important respects. The upper incisors each bear two parallel longitudinal grooves and the molar teeth are open rooted and continuously growing.

**Description:** As its name implies this is a rather large rodent, particularly the males. There seems to be some sexual dimorphism with the females generally averaging smaller than the males.

Externally they look very similar to Jirds of the Genus *Meriones*. The tail is well covered with hairs and comparatively thick with the distal one-third having longer dark brown or black hairs giving the tail quite a bushy appearance. In general body proportions it is a thickset heavy rodent with strong feet. All the digits bear well-developed black claws. The soles of the hind feet are comparatively hairy, the fore-feet have a vestigial thumb which however bears a claw and four well-developed digits (see Fig. 75). The black eye is set high in the skull and the muzzle is broad. The ears are comparatively small and well covered by hairs on both inner and outer surfaces. The vibrissae are noticeably long. In specimens from Pakistan the body fur tends to be rather reddish-fawn or gingery-buff in colour and less sandy-yellow than any *Meriones* species. The fur is thick and soft. The belly fur is whitish. A large male from Darzi Chach in western Baluchistan had the head and body 185mm ( $7\frac{5}{16}$ in.) with the tail 175mm ( $6\frac{7}{8}$ in.), the hind foot 39mm ( $1\frac{1}{2}$ in.) and the ear 15mm ( $\frac{1}{2}$ in.) in length. A female from the same area had the head and body length 171mm ( $6\frac{3}{4}$ in.), the tail 150mm ( $5\frac{7}{8}$ in.), the hind foot 39mm ( $1\frac{1}{2}$ in.) and the ear 14mm ( $\frac{1}{2}$ in.).



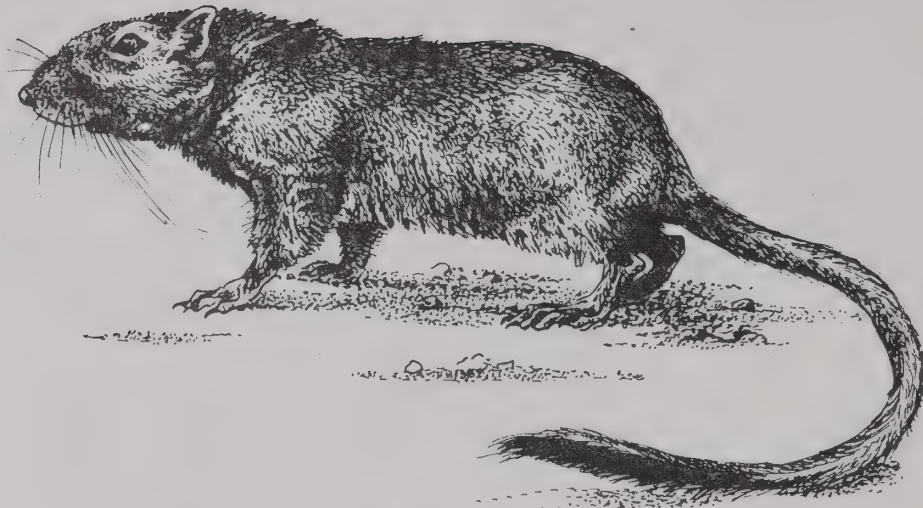
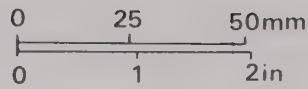


Illustration 87 *Rhombomys opimus*: Giant Day Jird or Great Gerbil. (Based on captive specimens in possession of J. A. W. Anderson, adult male from Darzi Chach, south west Baluchistan.)

**Distribution and Status:** In other parts of its range the Giant Jird inhabits a variety of areas in steppic mountain and upland desert regions. In the only regions of Pakistan where it has so far been found it inhabits rolling sand-dunes at over 915m (3000ft) elevation.

In the present state of our knowledge this jird is of very restricted distribution on the borders of Pakistan adjacent to the Seistan basin in southern Afghanistan. It was first col-

lected in 1967 by J. A. W. Anderson in areas to the north and west of Nushki in the Chagai plain (Lay, 1967).

Elsewhere it occurs in the Kara-Kum Desert in Russian Turkestan from whence it was first described in the 1820s. It was not until more than 100 years later that it was discovered in the extreme north eastern part of Iran in Khorassan, as well as further to the west on Gorgan. The Street Expedition collected it in the same places in the 1960s (Lay, 1971). It has been collected throughout most of northern Afghanistan in the loess steppe regions north of the Hindu Kush. It has been collected from around Herat, Maimana, Mazar-i-Sharif and Kunduz (Niethammer, 1965 and Hassinger, 1968).

In Baluchistan it was trapped in the same biotope as *M. libycus* and *J. blanfordi* and these were comparatively arid sand-dune regions away from cultivation. It is of no economic importance in Baluchistan though it is considered a pest in the USSR, causing damage to crops, as well as to railway embankments with its extensive tunnelling.

**Biology:** This jird is very similar in habits to *Meriones libycus* and indeed can be found occupying the same habitat. It is colonial, excavating a number of extensive burrow systems in the same vicinity. Furthermore it is diurnal. The burrows at Darzi Chach were so extensive that they could not be fully excavated, but one system appeared to extend for 13m (43ft) below the surface to a depth of 1.75m (5¾ ft) (Lay, 1970).

More than one individual appears to share the same burrow complex and they can be kept in groups of mixed sexes in captivity without fighting.

The Giant Day Jird appears to be largely herbivorous and its open rooted grinding teeth would be well adapted to such a diet. They probably feed on all kinds of succulent desert plants as well as grass stems. In Iran they frequently seemed



*Rhombomys opimus* Known distribution  
Probable range

Distribution Map 112 Great Gerbil or Giant Day Jird.

to be associated with the Saltwort bush *Salsola* (Lay, 1967). They store food for winter use in their underground burrows. Russian studies (Sokolov et al., 1963) indicate that this rodent is not graminivorous like *M. libycus* in the same regions, being strictly herbivorous. This jird does not hibernate in winter and will feed above ground even when there is snow on the surface. Probably during exceptionally cold spells they remain underground feeding on their food reserves.

Litters seem to be produced mainly in the spring and summer months with adult females producing two litters per year. From two to eight young have been recorded and four or five is believed to be the average number (Walker et al., 1964). In Iran on 25 October Dr. Lay excavated from a burrow a suckling young whose eyes had not yet opened (Lay, 1967).

The Giant Jird feeds mainly in the early morning and late

regions and there are no truly tropical forms. They are highly specialized for subsisting upon a coarse herbivorous diet and often obtain part of their food by burrowing. Their tails are well covered by hair and relatively short. Apart from having specialized grinding teeth, the skull also shows specialization for dealing with a tough fibrous diet since its shape is modified to facilitate the attachment of large jaw muscles, often with a squamosal crest or ridge developed on each side of the skull (see Fig. 67). The *Microtinae* include all the voles and lemmings.

#### Key to the Subfamily MICROTINAE

Dental formula: incisors, 1/1; canines, 0/0; molars, 3/3.

Usually rather small rodents of mouse-like form but adapted to a fossorial existence with relatively short tails and

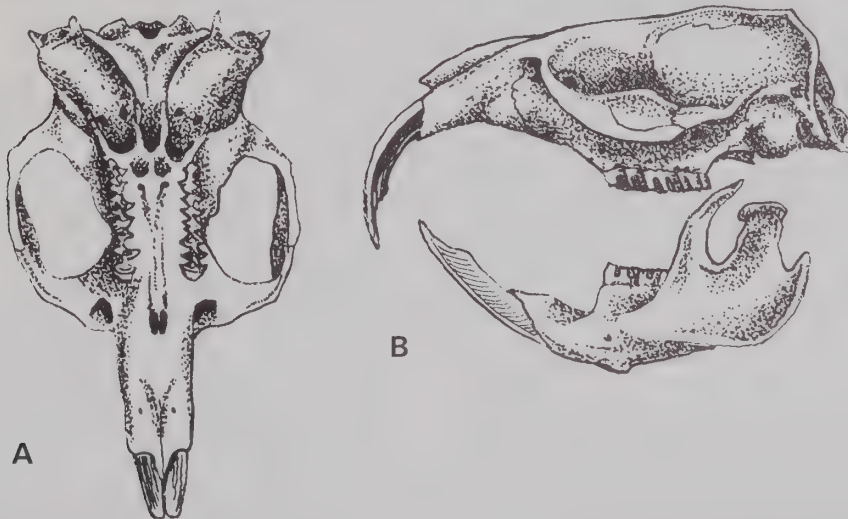


Fig. 76 Showing skull of *Ellobius fuscocapillus*.  
A. Ventral view.  
B. Lateral view with mandible.  
Note extremely long developed prurodont incisors

adapted for this rodent's fossorial existence. Note also fused palatal foramen and prominent sagittal crest.

afternoon. Like many diurnal and colonial rodents they have developed audible alarm signals. Unlike the *Meriones* species this jird has an audible whistle-like call when danger threatens. J. A. W. Anderson trapped an immature specimen at night-time on the surface which indicates that they are not exclusively diurnal (Lay, 1970). Meyer-Oehme also found remnants of this jird in owl pellets (Niethammer, 1965) which further indicates nocturnal activity. They are probably preyed upon by Marbled Pole Cats (*Vormela peregusna*) and Hill Foxes (*V. vulpes griffithi*) which occur in the same area.

E. Walker (1964) states that some individuals in the wild may live for more than two years.

#### SUBFAMILY MICROTINAE – THE VOLES AND LEMMINGS

Though this subfamily represents species which are generally considered as belonging to the Family *Cricetidae* they are a very distinct group and appear to be very successful ecologically having evolved a large number of closely similar species and forms which have spread throughout the northern hemisphere.

Broadly speaking, they are Holarctic rodents from cooler

small ears and short hind feet. Cheek teeth prismatic with many species having rootless continuously growing molars.

#### Genus ELLOBIUS Fischer, 1814

There are probably four species (Vorontsov et al., 1969) in this Genus which are confined to Asia Minor, southern Asiatic Russia, Mongolia and down to the north western corner of the Indo-Pakistan subcontinent. They are highly specialized for a subterranean burrowing existence and are the most completely adapted to a fossorial existence amongst all the *Microtinae*.

#### Key to the Genus and Pakistan Species of ELLOBIUS

Modified for a subterranean existence with soft dense body fur and both eye and external ear pinna vestigial and scarcely visible. Tail hair covered and very short being less than the hind foot in length. Upper incisors prurodont and covered with white enamel. Cheek teeth rooted with the last or third molar relatively small in size (see Fig. 76).

... *Ellobius fuscocapillus*



**ELLOBIUS FUSCOCAPILLUS**

*Ellobius fuscocapillus* Blyth, 1843; Quetta Mole Vole or Afghan Mole Vole (see Illustration 88).

**Description:** This Mole Vole is so modified for a subterranean existence that it looks very different from any of the rodents hitherto described. Its eye is reduced to a tiny pinhole in the skin, and it has probably partly lost the power of sight. The muzzle is short and bluntly rounded and the upper and lower incisors are markedly prouodont so that they are always exposed in front of the mouth even when the lips are in normal closed position. The broad incisors are covered with white enamel and the upper pair are smooth without any longitudinal grooves (see Fig. 67). The body is smoothly cylindrical with practically no neck and covered with very short dense fur. This velvety pelage minimizes friction when the animal is pushing through the soil and helps it to move with equal facility backwards as well as forwards. In Russia the closely related species *Ellobius talpinus* is often trapped for the fur trade. The tail is extremely short, though covered with hairs, and is roughly equal to or shorter than the hind foot in length. The external ear pinnae are so tiny as to be almost completely concealed in the body fur. Surprisingly for such a fossorial rodent the fore-feet are not very strongly developed for digging nor do the digits bear very long claws. There is a vestigial thumb on the fore-foot which does bear a claw. There are five digits on the hind foot with the outer toes being much shorter than the three centre ones. These toes are well fringed with hairs. *Ellobius fuscocapillus* varies somewhat in colour but the body fur is generally a rather striking golden-tinger colour with an indistinct mask of greyish-black hairs extending from the front of the muzzle backwards through the eyes. Usually the lower cheeks are more reddish coloured and the rest of the body a paler sandy hue. The belly fur is a paler greyish-yellow colour. Some specimens are more rufescent and others are a paler yellow colour. Also the extent of black around the fore-part of the face varies from one individual to another. The vibrissae are plentiful and comparatively better developed than in *Hyperacrius* Voles. The skull shows great modification for digging and there is an unusually broad gap (diastema) between the incisors and the molars.

Four specimens from Baluchistan had the head and body length averaging 133mm (range 118–143mm), with the tail averaging 13mm (range 11–15mm) in length, and the hind feet averaging 23mm (range 20–25mm) in length. The ear which is practically vestigial varied from 2–3mm ( $\frac{1}{16}$ – $\frac{1}{8}$ in.) and in dried skins cannot be seen at all. As can be seen from the measurements of the largest specimen, which was collected from Mach in eastern Baluchistan, this is quite a large vole compared to the very small field voles in western Europe.

**Distribution and Status:** It is characteristic of arid mountain steppe country, but seems to need fairly deep soil and is generally confined to valley bottoms around the borders of cultivation, or lower mountain slopes. It will be found in areas where the soil is very stony or gravelly but it certainly avoids soft sandy substrata as well as rocky hillsides.

There are very few definite records of the occurrence of this Mole Vole in Pakistan. So far it has not been collected anywhere in the North West Frontier Province or in the northern part of Baluchistan. At the beginning of this century, Col. Hotson collected specimens from Mach and eastern



Distribution Map 113 Quetta Mole Vole or Afghan Mole Vole.

central Baluchistan. It has also been collected in parts of Kalat. Surprisingly no specimens were collected by the University of Maryland Expedition during extensive travelling through Baluchistan. And I have failed to locate its burrows in the main Quetta valley, whereas *Nesokia indica* seems to have increased its range in all the lower valleys of Baluchistan and it may well be that this very aggressive rodent has pushed out the Quetta Mole Vole from some of its former haunts. *Ellobius* must therefore be considered as very local and rather erratically distributed, if indeed it still survives in Pakistan territory. Outside of Pakistan, it seems to be much more plentiful. In Iran it ranges throughout the northern plateau areas of that country and extending right up to the borders of Turkey (Lay, 1967). In Afghanistan its distribution also seems to be somewhat erratic and sparse though it has been known in that country since 1887. Dr. Niethammer found it 70km (44 miles) south west of Kabul, also near the Unai Pass, 30km (18 miles) south of Herat (Niethammer, 1965). J. D. Hassinger collected it also from Herat (Hassinger, 1968). It also occurs in south west Russian Turkestan and the Kopet Dag, just north of Iran (Bobrinskii et al., 1965).

Since it favours cropland and makes very extensive burrow systems it sometimes does damage to wheat crops, but it is apparently too rare to be a serious pest in Pakistan.

**Biology:** The presence of this Mole Vole is revealed in much the same way as *Nesokia indica* since excavations from its tunnels are pushed to the surface in small pyramids of loose soil. They excavate a very extensive system of tunnels which are quite close to the surface, generally only 3cm ( $1\frac{1}{2}$ in.) deep, which are used for foraging and searching for succulent roots, bulbs, rhizomes and tubers upon which it mainly feeds. It also excavates a much deeper burrow system for its living quarters and one such burrow was 80cm ( $31\frac{1}{2}$ in.) deep (Ognev, 1950). It is possible that it occasionally comes onto the surface to feed and certainly it must supplement its diet with green leaves which it can obtain without exposing its body completely on the surface. Live specimens trapped

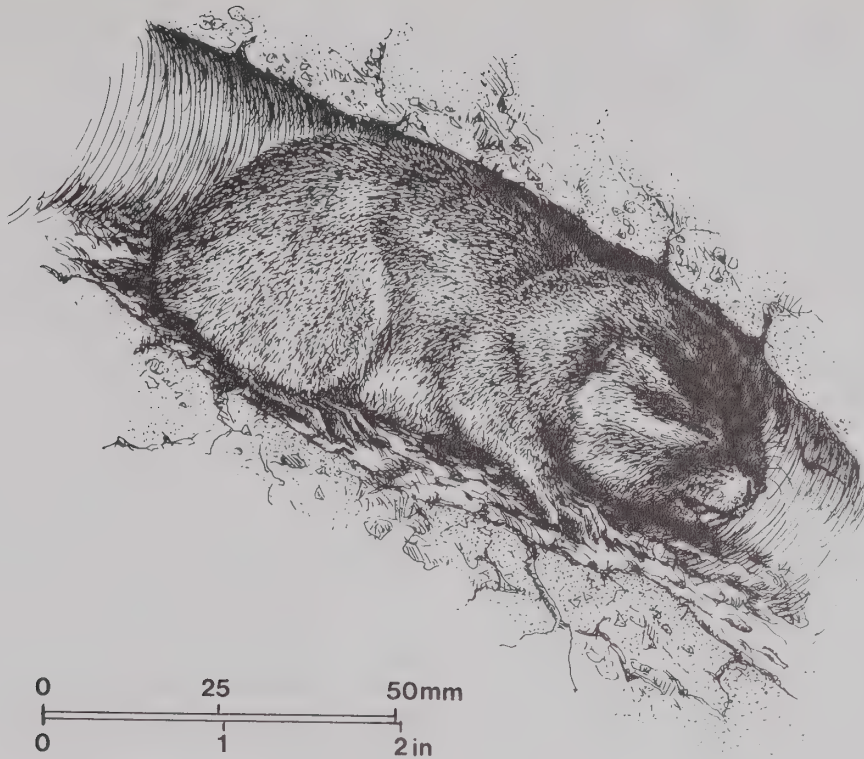


Illustration 88 *Ellobius fuscocapillus*: Quetta Mole-Vole or Afghan Mole-Vole. (Based on study specimens in the British Museum collection from Mach, Baluchistan.)

in Iran and released on the surface of the ground sometimes showed no inclination to burrow straight away, but roamed for extensive distances over the surface of the ground, nibbling at various plants (Lay, 1967).

In Baluchistan with its erratic rainfall and severe winters many herbaceous plants have developed underground food stores in the shape of bulbs and tubers and these would provide suitable food throughout the year. Insulated from temperature extremes in their subterranean burrows, they do not hibernate. The bulbs of *Scilla bobinackri* and *Tulipa chrysantha* common in the valleys of Baluchistan may provide a useful food source but their principal food in the USSR seems to consist of the rhizomes of grasses. They definitely make small underground food stores and chopped up vegetable matter has been found in such enlarged chambers underground (Ognev, 1950). There is evidence from some Russian observers that they will eat earthworms since a number of dried earthworms were found in one such underground foodstore (Ugryumyi, 1934 in Ognev, 1950).

Very little is known about the breeding of this Mole Vole. It is believed that there are generally two litters per year and that litter sizes generally vary from three to five, although as many as seven have been recorded (Walker et al., 1964). Ognev records for the closely-related *Ellobius talpinus* up to four litters born annually. Probably as with other *Microtines* the gestation period is relatively short and the young are quick maturing (Ognev, 1950). A juvenile specimen was trapped at Mach on 18 April.

Dr. Lay (1967) describes how a fresh caught specimen of this Mole Vole used its powerful front teeth to dig and throw out the soil. The fore-feet were only used to push the loosened soil backwards underneath the body. It braced its hind feet against the sides of the tunnel and pushed forwards

with its blunt muzzle. Occasionally it stopped digging with its teeth and kicked the soil backwards with powerful strokes of its hind feet. Two individuals took 15 and 19 minutes respectively to dig a tunnel in hard soil deep enough to completely conceal their bodies.

Living as it does, a largely subterranean existence, it is probably safe from predation by owls but it may be preyed upon by the Marbled Pole Cat (*Vormela peregusna*), and Hill Foxes (*Vulpes vulpes griffithi*) may also be able to dig it out from its burrows.

#### Genus ALTICOLA Blanford, 1881

This genus comprises five species of high altitude voles which are confined to the mountainous and steppe plateau areas of central and eastern Asia. They are distinguished from the other *Microtinae* genera by having the cheek teeth with rather wide folds and a long drawn-out appearance (see Fig. 77). They are not strong burrowers and have a fairly well developed tail and quite large ears compared with many of the more fossorial *Microtinae*. The soles of the hind feet have naked pads.

#### Key to the Genus ALTICOLA

Small mouse-like Voles with relatively long tail (more than 25 per cent of head and body length) and conspicuous ears (75 per cent of hind foot length).

Cheek teeth are rootless and continuously growing and their surface has wide folds and a long drawn-out appearance with the third or last molar not much reduced in size. Females with eight mammae.



### Key to the Pakistan Species of *ALTICOLA*

(i) Tail usually more than 30 per cent of head and body length and well furred. Ears 13–17mm long. Upper incisors not markedly pro-odont and pale yellow.

... *Alticola roylei*

(ii) Tail usually just under 25 per cent of head and body length. Third or last upper molar slightly reduced in size.

... *Alticola stoliczkanus*

### *ALTICOLA ROYLEI*

*Alticola roylei* Gray, 1842; Royle's High Mountain Vole (see Illustration 89).

**Taxonomy:** The Russian species, *Alticola argentatus* (Severtzov, 1879) known as the Silver Mountain Vole is considered by many authorities to be conspecific with *A. roylei*.

Ellerman and Morrison-Scott in their checklist (1951) list it as *A. roylei argentatus* (Severtzov). However some Russian authorities still consider that it should be regarded as a distinct and separate species from *Alticola roylei* (Dr. Gromov, Zoological Institute, Academy of Sciences, Leningrad, in lit., 1970). The taxonomy of this group is difficult, depending on minute differences in the molar tooththrow, and it appears that the majority of Russian zoologists, (Bobrinskii et al., 1965 and Geptner and Rossolimo, 1968) still consider *Argentata* as no more than a subspecies of *A. roylei*.

**Description:** These are rather handsome voles, having fairly prominent upstanding ears which are well covered on both surfaces with hair, and quite large eyes, when compared to most related species of *Microtinae*. The tail is comparatively long being generally about half the head and body length. It is generally bi-coloured being whitish underneath and is well covered with short hairs though annular rings can be discerned under the hairs. The body is rather thickset and cylindrical as in a typical vole and the muzzle is much rounder and blunter than in the mice (*Muridae*). The vibrissae are well developed measuring up to 37mm in length. The fur is very dense and velvety and often rather silvery-

grey dorsally. However there is considerable variation in colour with some specimens having a more rufescent tinge. The feet are whitish. The belly fur is a paler grey.

A series of thirty-two specimens of *Alticola roylei* from Pakistan had the following body measurements. The head and body length averaging 107mm (range 100–119mm) in length. The tail averaging 47mm (range 39–58mm) in length. The average length of the hind foot was 20mm (range 18–22mm) and the ear 15mm (range 13–17mm). Females have eight mammae of which two pairs are pectoral, widely spaced from two pairs located inguinally. A typical adult specimen weighs about 30–40g (1–1½oz), with 37g about the average.

**Distribution and Status:** *Alticola roylei* occurs in high mountain regions in the southern part of the Himalayas, down to valley bottoms in the northern dryer Himalayan regions. It occurs usually from the upper limits of the coniferous tree-line to the edge of the permanent snow-line which is around 5300m (17,000–18,000ft) elevation. It has been collected at 4300m (14,000ft) elevation in Gilgit. It has however been collected at as low as 2440m (8000ft) in Naran in glacial til and boulder strewn meadows.

It is found in Chitral, Swat Kohistan, Dir, Gilgit, Baltistan and the higher mountain ranges of Hazara District. They are absent from the Murree hills but occur in the Safed Koh Range of the North West Frontier Province. Elsewhere it has been collected in the extreme north western part of Afghanistan around Kamdesh and Ishkamish (Niethammer, 1965 and Hassinger, 1968). It has not been recorded in Iran. Its principal centre of distribution seems to be in Russian Tadzhikistan and extending eastwards to Chinese Turkestan, Mongolia and the Tianshan. It also occurs in the Pamirs.

**Biology:** Royle's Vole is partly diurnal in activity and is a surprisingly bold little animal so that it can often be seen by an observant person who is willing to climb up to the areas it frequents. It particularly favours slopes covered with tumbled rocks and talus, similar habitat occupied by Royle's Pika (*Ochotona roylei*). It shares many similar habits with the Pikas, such as collecting green vegetable matter which is carefully chopped and dried in little heaps for consumption

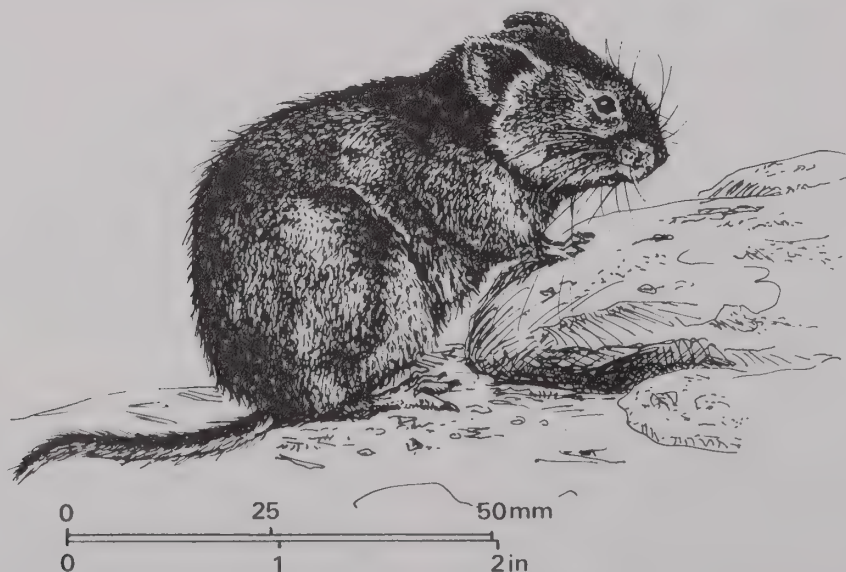


Illustration 89 *Alticola roylei*: Royle's High Mountain Vole.  
(Based on study specimens in Smithsonian National Museum, USA, from Kaghan Valley, Hazara District.)



*Alticola roylei* Known distribution (According to altitude)  
Probable range

Distribution Map 114 Royle's High Mountain Vole.

during the winter months. Like the Pikas, it deposits its faeces in particular places so that quite considerable accumulations may occur. These droppings may usually be found close to its burrow or rocky underground retreats, and being elliptical or banana shaped are quite distinctive from the spherical faeces of *Ochotona roylei*, indicating the presence of this vole. Even in areas which have heavy snowfall such as the higher mountain ranges of Hazara District, Royle's Vole does not hibernate in winter but tunnels along the surface of the ground and underneath the covering mantle of snow. The collection of seeds and dried chopped vegetable matter for such winter food stores forms a large part of its diurnal activity during the brief spring and summer season when there is suitable vegetative growth. It depends heavily on these food stores during the winter. Wild thyme, a species of eidelweiss and alpine milkvetch have been tentatively identified in such dried piles of food collected by this Vole. Generally they push these accumulations under overhanging stones, or in rock fissures, choosing places that are comparatively well ventilated. S. I. Ognev (1950) discovered one such store of *Alticola argentata* in a deep perpendicular rock fissure which he estimated contained about 1lb of fresh dried material. He also records that these busy little voles regularly turn over these piles of vegetable matter to expedite drying.

In the Kaghan Valley Captain Whitehead observed this vole eating stems of wild rhubarb (*Rheum emodi*) at an altitude of 3660m (12,000ft). This wild rhubarb is a common plant in the higher mountain regions of Baluchistan also. Like all the *Microtines*, Royle's Vole is largely herbivorous, feeding upon grass and leaves of alpine herbs, but depending more upon roots and bulbs in the winter. I have observed that these voles do not seem to fear the presence of man and frequently haunt Gujar camp sites in the Kaghan Valley and even enter deserted shepherds' huts to pick up food particles left by their transient human occupiers.

Not much has been recorded about the breeding of Royle's Vole though Russian zoologists have made a number of observations about the Silver Vole (*Alticola argentata*)

which is probably conspecific. Litter sizes for the Silver Vole vary from 3–5 and females produce two and occasionally three litters each year during the summer season (Ognev, 1950). A female of Royle's Vole collected in the Kaghan Valley in June contained four foetuses. Two more collected by me had 4 undeveloped foetuses on July 6 and 5 well developed foetuses on July 9. Juvenile specimens have also been trapped on July 24 and 25 in the Kaghan Valley, and from Gilgit in early August. Since the females have eight mammae, litters comprising more than five young may occur. High Mountain Voles are not particularly active burrowers and largely make use of natural rock crevices. The female produces her young in a nest which is concealed in some hollow under a rock. Dr. Bannikov found one such nest of the Silver Vole skilfully woven from grass fibres and sheep's wool which was circular in shape and concealed under a stone. It measured about 25cm (9 $\frac{3}{4}$ in.) in diameter (Bannikov in Ognev, 1950).

In areas of alpine meadow land and particularly near streams, Royle's Vole seems to be colonial, but in more arid regions there is no definite evidence and they appear to live rather more dispersed. Since they do not hibernate in winter they provide a vital food source for Stoats (*Mustela erminea*) which inhabit the same alpine regions and can enter the narrow burrows and rock crevices frequented by this Vole. They are also probably preyed upon by the Alpine Weasel (*Mustela altaica*) which occurs in the same alpine regions. Being partly diurnal they must also occasionally fall prey to raptors such as Kestrels (*Falco tinnunculus*) and Booted Eagles (*Hieraaëtus pennatus*) both of which may often be seen hunting over the alpine meadows frequented by this vole. The Himalayan Red Bear (*Ursus arctos*) has also been recorded as feeding on these voles and deliberately digging up their underground food stores (Stockley, 1928).

Where this high altitude vole occurs, it is often very abundant but since it is confined to such remote alpine regions it must be considered rather restricted in range in Pakistan and it is certainly of no economic significance.

#### ALTICOLA STOLICZKANUS

*Alticola stoliczkanus* Blanford, 1875; Stoliczka's High Mountain Vole.

This species is listed in Ellerman and Morrison-Scott's checklist (1951) as occurring in Kashmir, and it is included in M. S. Siddiqi's *Checklist of the Mammals of Pakistan* (1969) on the basis of a specimen in the British Museum collected in the Safed Koh range by Captain Whitehead. Z. B. Mirza in *The Small Mammals of Pakistan* (1969) gives the range of this species as including Gilgit and Baltistan, though there are no specimens in the Smithsonian Institute or the British Museum from Baltistan.

It seems doubtful therefore whether this species actually occurs within Pakistan territory. In the collections of the British Museum and the Bombay Natural History Society all the specimens of *A. stoliczkanus* except one have been collected in the eastern Himalayas extending westwards only as far as Ladakh, but not further into the adjacent provinces of Baltistan in Pakistan territory. There are specimens from Tibet as well as Nepal but no specimens from Gilgit or Baltistan. The single specimen from the Safed Koh Mountains which has been labelled *Alticola stoliczkanus* has been examined by Dr. Niethammer who is of the opinion that it is a sub-adult specimen of *Alticola roylei* (J. Niethammer, in lit., 1969). Since this locality is many hundreds of miles



south west of the known distribution range of *Alticola stoliczkanus* it seems highly probable that this was a case of mistaken identification. The distinction between these two species is very difficult to determine in the case of sub-adult specimens, but after examination of the same British Museum specimen I am inclined to agree with Dr. Niethammer.

Genus **HYPERACRIUS**    Miller, 1896

This is a genus of fossorial voles closely related to the high altitude central Asian voles of the Genus *Alticola*. *Hyperacrius* differs from *Alticola* by the presence of a prominent inter-orbital ridge in the cranial region of the skull which is lacking in *Alticola* (Ellerman, 1961). As presently known the genus comprises only two species confined to a very limited region of the north west Himalayas.

Ecologically this genus is very interesting in that these two species appear to have adapted to an almost exclusively subterranean or fossorial existence and they have spread further south than any of the other Palearctic *Microtines*.

Key to the Genus **HYPERACRIUS**

Fossorially adapted Voles with bluntly rounded head and very small ears (roughly one-tenth of head and body length) partly concealed in body fur. Cheek teeth rootless and prismatic with relatively long-drawn-out appearance (see Fig. 77). Tail hair covered and about one and a half times the length of the hind foot. Incisors prurodont. Females with six mammae.

Key to the Pakistan Species of **HYPERACRIUS**

- (i) Ear averages 9.6mm — exceptionally 10mm. Head and body length 107–130mm. Dorsal fur usually blackish brown and very soft (lax).  
... *Hyperacrius wynnei*

- (ii) Ear averages 11 to 13mm. Head and body length 90–110mm. Dorsal fur usually dark reddish brown and harsher.  
... *Hyperacrius fertilis*

**HYPERACRIUS WYNNEI**

*Hyperacrius wynnei*    Blanford, 1881; Murree Vole (see Illustration 90).

Synonym *Microtus wynnei*    Miller, 1899; Wynne's Vole.

**Description:**    This is a rather large vole of very dark colouration. Due to its fossorial adaptation the head is comparatively massive with prominent prurodont incisors (see Fig. 67). The body is thick and cylindrical and the tail very short as compared with *Alticola* species.

The fur is particularly soft and comparatively long and generally dark blackish-grey in colour with only the tips of the hairs showing a brown tinge. After the moult the general body colour appears more buffish-brown but there is insufficient evidence to indicate whether variation in the colour of fur relates to the age or the period of moult of specimens. I have trapped both very dark and paler brown examples in the same piece of ground during June and July in the Murree Hills. Compared with *H. fertilis* the body fur is definitely more lax and soft, with the belly fur dark grey and less rufescent.

The eye of the Murree Vole is extremely tiny and it would appear to have very limited vision. The very small rounded ear is completely concealed in the long body fur (see Fig. 70) and if a number of specimens can be compared it will be found to average smaller in size than the ear of *H. fertilis*, 9–10mm ( $\frac{3}{8}$ in.) being a typical length compared to 11mm ( $\frac{7}{16}$ in.) for *H. fertilis*. This smaller ear size concurs with ecological differences since *H. wynnei* is more truly fossorial. The vibrissae are comparatively short and soft, the longest measuring about 20mm ( $\frac{13}{16}$ in.). The tail is well clothed with

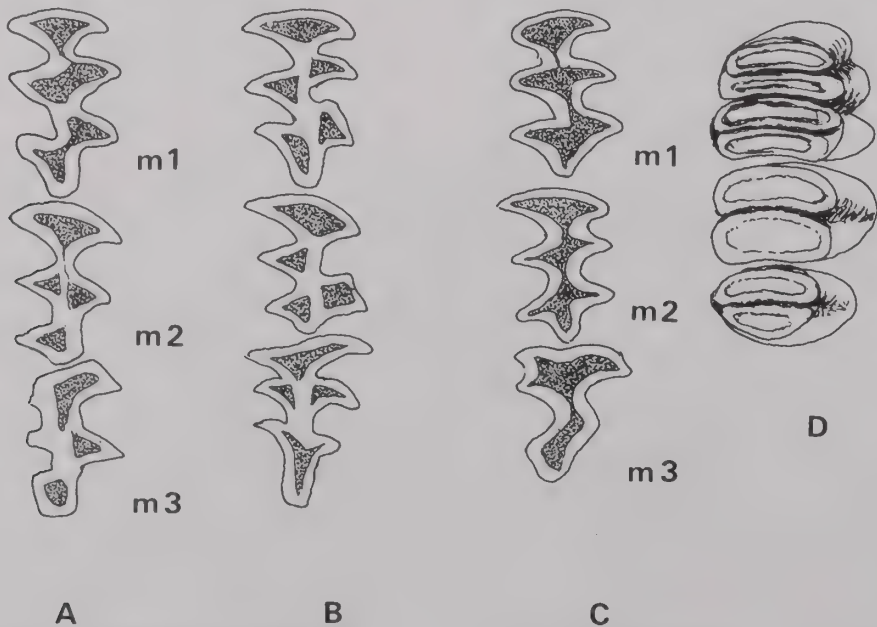


Fig. 77    Showing comparison between upper right side (maxillary) tooth row of a rat and certain voles:  
A. *Hyperacrius wynnei*.  
B. *Alticola roylei*.  
C. *Ellobius fuscopillus*.

D. *Nesokia indica*.  
Note flat crowned prismatic cheek teeth of the *Microtines* (Vole species) with rounded teeth of *Nesokia* having compressed folds.

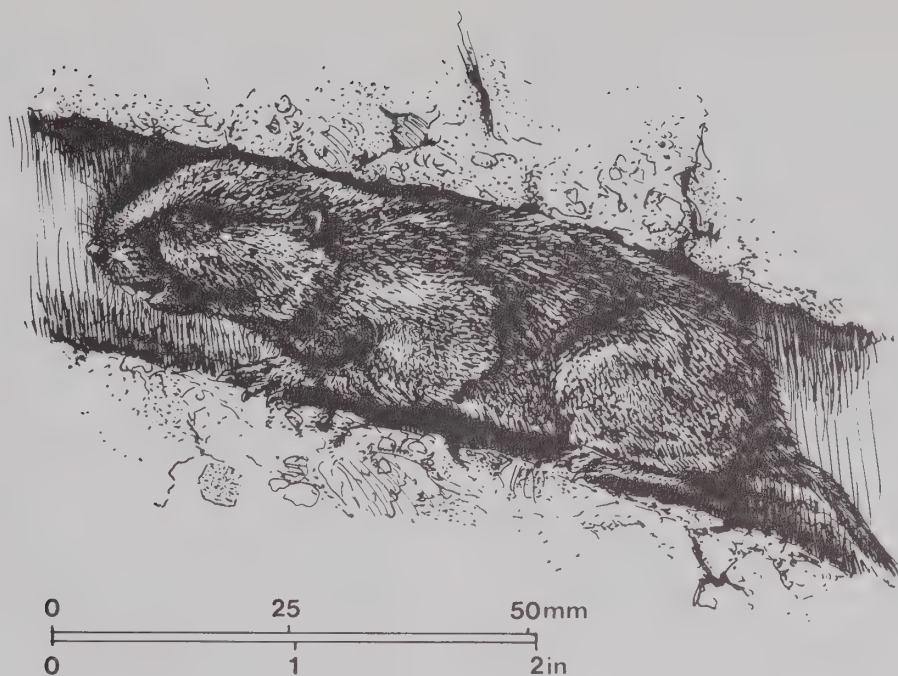


Illustration 90 *Hyperacrius wynnei*: Murree Vole. (Based on fresh killed specimen collected April in Dunga Gali, Murree Hills.)

short hairs and slightly bi-coloured. The short fore-limbs are strongly developed for digging, each digit being armed with comparatively long claws though the actual digits appear comparatively small (see Fig. 70). There are five digits on the hind foot and four on the fore-foot with a vestigial thumb. The muzzle is bluntly rounded and deep, and the upper incisors are covered with pale yellow enamel being ungrooved on their anterior surface.

The female always has six mammae, an important distinguishing feature from the genus *Alticola* which appears invariably to have eight mammae. There is always a high proportion of sub-adult specimens in the population of this vole. Out of 81 specimens trapped from the Kaghan Valley and housed in the Smithsonian National Museum, only 14 could be classified as adults according to skull characteristics (Phillips, 1969). Immature specimens are a darker grey in pelage colour.

Average size of 37 specimens collected from the Murree Hills, Hazara District and Swat were as follows: head and body length averaging 115mm (range 101–138mm), the tail averaging 32mm (range 24–39mm). The ear averaged 9.6mm (range 6–12mm) and the hind-foot 20mm (range 17–22mm). J. R. Ellerman in his key (1961) separates *H. wynnei* from *H. fertilis* on the basis of larger skull and tooth row length. There is much variation between individuals and the tooth row length is very difficult to measure mechanically. Moreover mature specimens form a comparatively small proportion of the population, however this measurement seems to be a fairly reliable indicator. Five typical skulls of *H. wynnei* from the Murree Hills averaged 27mm ( $1\frac{1}{8}$  in.) occipito-nasal length with upper molar tooth row length 7mm ( $\frac{1}{4}$  in.). Six adult specimens varied from 42–60g (average 52.6g) in weight.

**Habitat:** This vole is typically associated with Himalayan moist temperate forest and is found from about 1850m

(6000ft) elevation up to 3050m (10,000ft) both within forest and open grassy slopes. It is typically associated with the silver fir (*Abies pindrow*) and the blue pine (*Pinus excelsa*). However it has spread to the summit of mountains such as Mukshpuri at 2800m (9300ft) elevation. There appears to be an overlapping of the range between these two *Hyperacrius* species and *H. wynnei* certainly occurs above 2500m (8200ft) contrary to what has been stated previously (Phillips, 1969).



*Hyperacrius wynnei* Known distribution  
Probable range



*H. wyneei*, however, does not ascend to such high altitudes as *H. fertilis* and can be considered more of a forest species.

It is abundant throughout the forest region in the Murree Hills extending westwards through the lower forested regions of Hazara District (Shogran in the Kaghan Valley) across the Indus to lower Swat where it has been collected by the University of Maryland Expedition at Changla and Yakhtangi. It has not been recorded anywhere outside of Pakistan at present, neither has it been able to extend its range northwards into the dryer sub-alpine regions of Chitral or Gilgit. J. Niethammer failed to trap it in Afghanistan although he was on the lookout for this species (Niethammer, in lit., 1968).

Though the Murree Vole is quite plentiful in regions where it occurs, there is very little cultivation in the Himalayan moist deciduous forest zone above 2150m (7000ft) so that this vole is not usually of any economic importance. It will however do some damage to upland potato crops, and has been reported as gnawing the bark off apple trees in winter when snow carpets the ground, in the lower Kaghan Valley.

**Biology:** The Murree Vole excavates an extensive network of comparatively shallow feeding tunnels as well as having much deeper tunnels descending almost vertically into the ground. These latter are used as sleeping and breeding quarters. Being highly fossorial they are not much influenced by seasonal temperature changes and may feed actively during the day as well as night. Despite the heavy snowfall and severe winter conditions in the regions inhabited by this vole, they do not hibernate. During the winter they construct special runways or tunnels near or on the surface of the ground and beneath the snow cover. Presumably the ground is frozen hard in such regions, whereas the micro-climatic conditions just above the surface of the ground do not go below freezing due to the effect of the snow layer. *Hyperacrius* voles therefore occupy an equivalent ecological niche in the Himalayas to the Snow Vole, *Microtus nivalis* in northern Europe. When the snow melts in the spring it can be seen that the tunnels or runways of these *Hyperacrius* voles are roofed over with a thin layer of matted chewed vegetable matter and soil particles. Possibly this prevents the snow arch from collapsing and this lining must be constructed and applied by the Vole's mouth. The same phenomenon was noticed and commented upon in Kashmir (Macgrath, 1912). Where there is a slight rise in the ground these tunnels dip beneath the surface of the soil and are conspicuous in mid April and they criss-cross in a veritable maze of fairly straight lines on suitable grassy slopes. I have found such winter runways exposed beneath melting snow which was reported to have earlier reached a depth of 2.14m (7ft) in February.

During winter these voles presumably feed on dead grass and other vegetation on the surface. The summer runways are from 32–75mm (1¼–3in.) below the surface and they presumably feed largely on roots and underground stems. Many authors repeat the information given by Major H. H. Dunn that these voles are mole-like in habits (Walker, 1964 and Phillips, 1969). Actually they appear to be exclusively herbivorous and examination of stomach contents of three specimens revealed no evidence of soil living invertebrates being taken in the diet. They make underground food stores at the end of the monsoon season since they can be observed during August and September pulling plants into their burrows. I have observed them being particularly active at this season and pulling large plants bit by bit into

their underground tunnels. In the Murree Hills a favourite plant is the rather large and tall Ragwort (*Senecio chrysanthemoides*). I have also seen them feeding on another large leaved forest plant, *Doronicum roylei*. In the late summer they will also do considerable damage to potato crops in the higher hill regions and I have trapped them in such crops at Dunga Gali. The only mole-like habit which they evince is in pushing up pyramidal heaps of loose granular soil at irregular intervals from their burrows.

The Murree Vole is loosely colonial in habits. They can be heard and observed feeding at all hours of the day if approached cautiously, though they are very sensitive to vibrations from passing footfalls whether of humans or animals and at once stop feeding activity. There is some evidence that the young specimens are less fossorial since a young specimen was captured above ground during grass mowing in Nathia Gali in June. An immature specimen was also caught by a domestic cat at night in a garden at Murree (C. Priddy, pers. comm. 1965). Information about breeding biology is scanty. It is known that the female constructs a grass lined nest at the end of a deep burrow in which she produces her young. Half and three-quarter grown specimens, which were presumably 4–6 weeks of age, have been trapped in early June as well as on 8 October which indicates that females probably produce two or three litters each summer. A lesser number of mammae in this genus compared with *Alticola* seem to indicate smaller average litter sizes. Of two females trapped in early August, one bore two embryos and the other had three placental scars. The high proportion of subadults collected in trapping operations seems to indicate that few adults live beyond about 18 months of age and there is probably high mortality in the second winter of their lives.

*Apodemus sylvaticus* has been trapped in the same biotope.

## HYPERACRIUS FERTILIS

*Hyperacrius fertilis* True, 1894; True's Vole or Burrowing Vole.

Synonym *Microtus fertilis* Miller, 1896.

**Description:** True's Vole averages smaller in size than the Murree Vole and the tips of the hairs are generally more reddish-brown so that it is much less dark in overall appearance. The fur feels harsher but is equally dense. The under parts have the hairs dark grey basally with paler ochraceous-buff tips. The tail is always dark grey dorsally and bi-coloured. The ear appears slightly more conspicuous in this species as compared to *H. wyneei*.

Four typical skulls from the Kaghan Valley averaged 24mm (1½in.) occipito-nasal length with the upper tooth row 6.2mm (¼in.) in length. Out of 27 specimens from Hazara District selected from the Smithsonian and Bombay Natural History Society collections the head and body averages 102mm (range 96–113mm) in length with the tail averaging 31mm (range 24–40mm) in length, the hind foot averaging 17mm (range 16–19mm) and the ear averaging 11mm (range 10–13mm) in length. Four adult specimens varied from 21.5–23g in weight.

The baculum of these two species differs markedly and could be used to separate individual specimens. That of *H. fertilis* has a longer and narrow stalk with the proximal tuberosities being weakly developed and the distal tip triangular in shape. The baculum of *H. wyneei* has a shorter stalk with a broader heavier proximal half expanded into

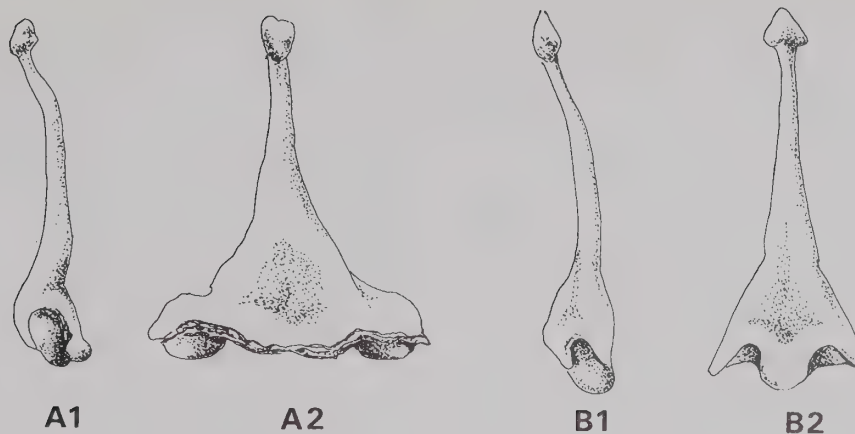


Fig. 78 Showing difference between the baculum (*os penis*) of *Hyperacrius* (Vole species):  
 A1. Lateral view.  
 A2. Ventral view of *os penis* of *Hyperacrius wynnei*. Note expansion of proximal half of bone with prominent basal tuberosities and a comparatively short and

heavy stalk.

B1. Lateral view of *os penis* of *Hyperacrius fertilis*.

B2. Ventral view.

Note proximal half not widely expanded with stalk long and slender.

prominent tuberosities. The tip is rounded and not triangular (see Fig. 78).

**Distribution and Status:** True's Vole is typically associated with the subalpine scrub zone and alpine meadows and it is normally found well above the limit of the tree line. In contrast to *H. wynnei* it is more adapted to less mesic conditions and is somewhat less fossorial since it often inhabits more rocky areas at higher altitudes. It has been collected at 3600m (11,800ft) elevation in the Chilas District of Gilgit. However it has been collected down to 2450m (8000ft) elevation in Hazara District in grassy areas adjacent to forest in biotope identical to that of *H. wynnei*.

It is more widely distributed than the Murree Vole and has been trapped around the lower slopes of Nanga Par-

bat as well as on the lower Deosai Plateau in Baltistan. It apparently does not occur in the Murree Hills but is partly sympatric with *H. wynnei* in the southern part of Hazara District (e.g. around Shogran). It has also been collected in the Bogamarg Valley north of Manshera and the University of Maryland Expedition discovered it in Swat Kohistan, trapping it around Utrot and Ushu as well as in Dir State on the Lowarai Pass. Outside Pakistan it has been collected in the Pir Panjal range whence the original type specimen originated. It also occurs throughout the higher alpine zones to the north of the main Vale of Kashmir but there are no records of its distribution east of Dachin in the extreme end of the Pir Panjal Range. It has not been recorded in Afghanistan or anywhere in the USSR.

Even in the hand it is extremely difficult to separate individual specimens of this vole from *H. wynnei*. But they appear to be much more distinct ecologically, and as indicated above, True's Vole averages smaller in size, inhabits higher elevations above the forest zone and has a lighter more rufescent ventrum with pelage which feels distinctly hispid to the touch. *H. fertilis* has been trapped in the same biotope as *Alticola roylei* and *Apodemus sylvaticus*. There is no evidence that this vole is of any economic importance.

**Biology:** Like the Murree Vole it is believed to be exclusively herbivorous, to feed principally on succulent grass roots and stems and to burrow underground extensively. However it will forage above ground and is certainly not so completely fossorial as the Murree Vole judging from the fact that specimens enter traps placed above ground whereas the Murree Vole can only be captured by sinking traps into their subterranean tunnels. I have trapped it at Buruwai, Hazara District at 3050m (10,000ft) elevation on rocky slopes where the only vegetation was the Dwarf Elder (*Sambucus ebulus*), [synonym (*Sambucus wightiana*)], and in another region where it appeared to be feeding on the subterranean roots of *Eremurus*. It is not a highly gregarious species though they may occur in loose colonies. They apparently do not hibernate. One specimen was trapped in the Kaghan Valley foraging above ground on 3 December.

Presumably, like the Murree Vole, they excavate deeper tunnels for shelter during the winter as well as for breeding



*Hyperacrius fertilis* Known distribution  
 Probable range

Distribution Map 116 True's Vole or Burrowing Vole.



activity and two to three litters are born during the spring and summer months.

#### Genus PITYMYS Mc.Murtrie, 1831

There are eleven voles in this genus of which three are confined to Nearctic regions and the remaining eight are Palearctic but also confined to drier, more southerly latitudes (Walker et al., 1964 and Van den Brink, 1967).

With comparatively long bi-coloured tails and conspicuous ears these voles are superficially closely similar to *Alticola* species. However, the first lower molar has only three closed triangles on its grinding surface in contrast to four found in *Alticola*. The bony palate which forms a bridge between the two tooth rows in the upper jaw has two relatively deep pits or canals separated by a median ridge. In *Alticola* the bony palate is relatively straight and flat without these deep canals. The top of the skull is relatively smooth and flat without prominent supra-orbital ridges as in *Hyperacrius*.

#### Key to the Pakistan Species of PITYMYS

A dark brown vole with belly fur a paler silvery-grey, and well developed ears.

First lower molar having only three closed triangles on its grinding surface and in the upper jaw the bony palate forming a bridge in its rear portion bearing two deep parallel pits separated by a raised median ridge (see Fig. 79).

#### PITYMYS CARRUTHERSI

*Pitymys carruthersi* Thomas, 1909; Carruthers' Vole.

**Taxonomy:** Because the sub-family Microtinae contains a huge number of closely similar species, taxonomists have attempted to clarify their relationships by establishing a number of genera and sub-genera, sometimes based on very minute dental or cranial differences. *Pitymys* is treated as a distinct genus by Ellerman (1961) which is followed in this book. The vole species of this genus occurring in nearctica and Europe, are in fact easily separated by a number of characteristics, but these are not constant when we come to consider the Microtinae of the USSR and Caucasasia. Hence most Russian authorities treat *Pitymys carruthersi* as no more than a sub-genus of *Microtus*, and also consider *Neodon* as well as *Phaiomys* as being sub-genera of doubtful value, describing the species as *Microtus carruthersi* (Gromov et al., 1963 and Flint et al., 1965). Carruthers' Vole has more recently been considered as a sub-species of *Microtus juldascchi* by some Russian zoologists (Bobrinskii et al., 1965).

Certainly the recent records of distribution of *Microtus juldascchi* from the Pamirs and Wakhan of north-eastern Afghanistan (Hassinger, 1968) together with the known distribution of *Pitymys carruthersi* in the USSR, indicates the possibility of their being conspecific (see Bobrinskii et al., 1963, and Flint et al., 1965). The British Museum is currently engaged upon a revision and review of the palearctic mammals

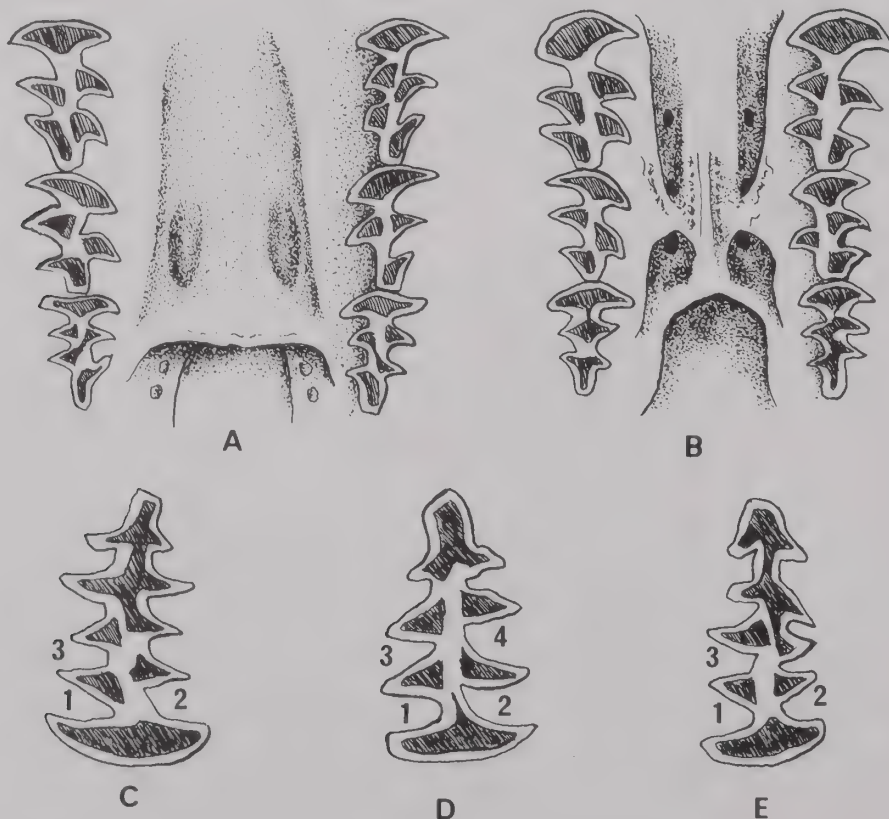


Fig. 79 Showing difference between bony palate of *Alticola* and *Pitymys* voles and comparison of first lower molars.

A. Upper palate showing both molar tooth rows of *Alticola roylei*.

B. Ditto, *Pitymys carruthersi*.

C. First right side molar in lower jaw of *Pitymys carruthersi*.

D. Ditto, *Alticola roylei*.

E. Ditto, *Pitymys juldascchi*.

and Dr. G. B. Corbet (pers. comm., 1975) who is working on the Microtines, also concurs with the Russian view and prefers to treat *P. carruthersi* and *P. juldaschi* as one species, there being no determinable or consistent characteristic to differentiate them in the series of specimens available in the British Museum. I have been fortunate to be able to examine the series of specimens in the Zoological Institute in Leningrad which houses the national collection, there being some 40 specimens of *juldaschi* and over 35 of *carruthersi* and they are easily separable on the basis of pelage colour, with *juldaschi* being markedly paler (straw brown), but there was no significant difference in body measurements or in the shape of the molar teeth which would differentiate these two voles.

**Description:** This is a slightly smaller vole than *Alticola roylei*. Five specimens in the British Museum collection and four from the Leningrad Zoological Institute averaged 95.8mm head and body length (range 105–83mm), 34mm in tail length (range 39–29mm), with the hind foot averaging 16.1mm (range 17–15mm) and the ear averaging 12.3mm (range 14–11mm). A single specimen from Pakistan had the head and body 112mm, tail 31mm, hind foot 19mm and ear 10mm.

Like *Alticola* voles, the species has comparatively large and conspicuous ears as well as a comparatively long tail indicating that it is not particularly fossorial in its habits. The pelage is soft and silky and of a darkish wood-brown colour dorsally, being silvery-grey ventrally. The under fur is leaden-grey coloured and the feet and claws are comparatively small and delicate. The tail is markedly bi-coloured, being silvery white on its ventral surface. The head and muzzle is typically rounded and blunt like other Microtines. Carruthers' Vole is distinctly smaller than the Sikkim Vole (*Pitymys sikimensis*) which occurs at the eastern end of the great Himalayan mountain chain. It is also distinguishable by having relatively larger tympanic bullae. The bullae are less than 6.5 mm in length in Carruthers' Vole (Ellerman, 1961).

The molars are open rooted and continuously growing and the first molar of the lower jaw has only three enclosed triangles in the pattern of its grinding surface compared to four found in *Alticola* species (see Fig. 79). The bony palate which forms a bridge between the two upper tooth rows has two relatively deep pits or canals on either side of a median ridge

whereas the bony palate of *Alticola* voles forms a relatively flat bridge in its posterior part. The supra-orbital ridges are not so prominent as in *Hyperacrius* voles and there seems to be no consistent pattern of their fusing into a single median crest in the fore part of the skull as was indicated by Ellerman in his key (op. cit., 1961).

**Distribution and Status:** This vole is an inhabitant of steppic mountain regions at high altitudes (10,000ft and over). It was originally discovered by the early twentieth century explorer Carruthers who collected a series from the Hissar mountains about 100 miles east of Samarkand, in Russian Turkestan (Carruthers, 1949).

In July 1974 Schaller obtained permission to travel up to the Pamir range in extreme north eastern Chitral, in search of evidence of Marco Polo Sheep, and trapped a single specimen of this vole near Baroghil at an elevation of 11,600ft. This vole was later identified by the American Museum of Natural History, and the specimen is now kept there, in spirit. This constitutes a new record of a new species for the sub-continent and I am grateful to Dr. Schaller for giving me this data and for permitting me to include his discovery in this book.

It is distributed throughout south eastern Russian Turkestan from Tashkent down to the Wakhan border but has not been recorded from Afghanistan though the sibling species *Microtus (pitymys) juldaschi* has been collected from the Pamirs adjacent to north eastern Chitral (Hassinger, 1968). As mentioned above the possibility of these two voles' conspecificity must be considered.

**Biology:** Only what has been recorded by Russian workers is known. It is not particularly fossorial but is adapted to live amongst rock crevices in stony ground as well as burrowing along the banks of streams (Gromov et al., 1963). It is herbivorous like most Microtines and succulent roots or rhizomes and bulbs probably form an important part of its diet since it is known to make winter food stores, and there is little vegetative growth during the long cold winter (Flint et al., 1965). It is also described as being gregarious in its burrowing habits (Bobrinskii et al., 1965).

Voies of the genus *Pitymys* have only two pairs of teats and presumably Carruthers' Vole has only two to three young per litter as is the case also with *Hyperacrius* voles in Pakistan.



## 13 CETACEA

This extraordinary order of mammals is wholly adapted to an aquatic existence, with reproduction as well as feeding taking place entirely in the water. It comprises two living suborders, with 38 genera and about 90 species (Walker et al., 1964).

One suborder is the *Odontoceti* comprising the dolphins and porpoises or toothed whales, having an asymmetrical skull and only one external orifice or blow-hole for breathing. The second order comprises the *Mysticeti* with no teeth but plates of baleen (modified mucous membrane) in the roof of the mouth and two breathing orifices. They occur in all the oceans of the world as well as some freshwater rivers and lakes.

### Key to Order CETACEA

Hind limbs absent and fore-limbs flattened into a paddle-shape. Body smooth, fish shaped and hairless.

... *Cetacea*

### Key to Suborder MYSTICETI

No teeth in lower jaw but palate fringed with vertical plates of whalebone or baleen. At least two separate breathing orifices in the top of the head.

... *Mysticeti*

### Key to Suborder ODONTOCETI

Lower jaw with teeth and a single breathing orifice in top of head.

... *Odontoceti*

## FAMILY BALAENOPTERIDAE – BALEEN WHALES

### Key to the Family BALAENOPTERIDAE and Genus BALAENOPTERA

Embryonic teeth replaced by baleen plates in adult animals. Body slender and streamlined with a small dorsal fin and pectoral flipper less than one-seventh head and body length, with parallel grooves in the throat and chest region.

... BALAENOPTERIDAE and *Balaenoptera*

### Genus BALAENOPTERA Lacepède, 1804

Comprising five species which feed mainly in arctic and antarctic waters. The Antarctic subspecies or populations migrate northwards in summer for breeding and some species regularly enter the Indian Ocean and are observable in shallow waters off the Mekran coast in summer.

### Key to Species of BALAENOPTERA occurring in Pakistan Coastal Waters

- (a) Baleen plates (whalebone) yellowish-white or blackish-slate coloured except anteriorly where they are always white on righthand side. Belly all white with from 70

up to 100 ventral grooves.

... *Balaenoptera physalus*

- (b) Baleen plates (Whalebone) all black. Belly slatey-blue with paler blotches and bearing 80 to 100 ventral grooves.

... *Balaenoptera musculus*

## BALAENOPTERA PHYSALUS

*Balaenoptera physalus* Linnaeus, 1758; Common Rorqual or Common Finback.

**Description:** A huge whale, with females which grow larger than males, regularly attaining lengths up to 18.25m (60ft) and even 19.75m (65ft), and weighing over 45,000kg (50 tons).

In appearance the Common Rorqual is long and slim, dark blue-black dorsally with a white belly. There is a small but quite distinct dorsal fin and there are no lighter blotches or spots on the body as in the Blue Whale. The throat and upper belly bears 60 to 90 parallel grooves which function to give the mouth greater flexibility when feeding. The pectoral flippers are elliptical in shape and white on their ventral surface. The most striking feature of this species is the asymmetrical colouring in the head region. The left side of the lower jaw is always a darker blue-grey whilst the right side is white in an irregular pattern, half being blue-grey and half white (see Fig. 83). All the fringes of the baleen plates are yellowish-horn coloured with some black patches in the plates on the left side also.

**Distribution and Status:** As is well known, the two largest species of whales being the most profitable sources of oil have already been hunted to the verge of extinction by the highly organized and competitive pelagic antarctic whaling fleets. However the Fin Whale is still not quite so rare as the Blue Whale and Karachi fishermen even in the early 1970s reported regular sightings of whales off the Mekran coast, particularly off Astola Island and Gwadar during the summer months. It can be presumed that these sightings are mostly of this species. In July 1969 local fishermen actually succeeded in ensnaring a young Fin Whale calf in their nets near Astola Island. It measured 10½m (35ft) in length. They managed to pass a rope around its body and actually to tow it back to Karachi. Apparently the mother followed its calf up to the entrance to the harbour but then returned to the open sea. It was put on public exhibition but was reportedly in distress and unable to swim in an upright position. On hearing of its capture the Director of the Zoological Survey made these fishermen tow the unfortunate calf back to sea and release it, but it is doubtful if it survived (M. S. Siddiqi, Director of the Zoological Survey of Pakistan, pers. comm., 1970).

In 1974 with the aid of local fishermen I identified two stranded specimens of this whale within a 12 mile stretch of coastline in Las Belas, both of which had come ashore in the winter of 1973/74.

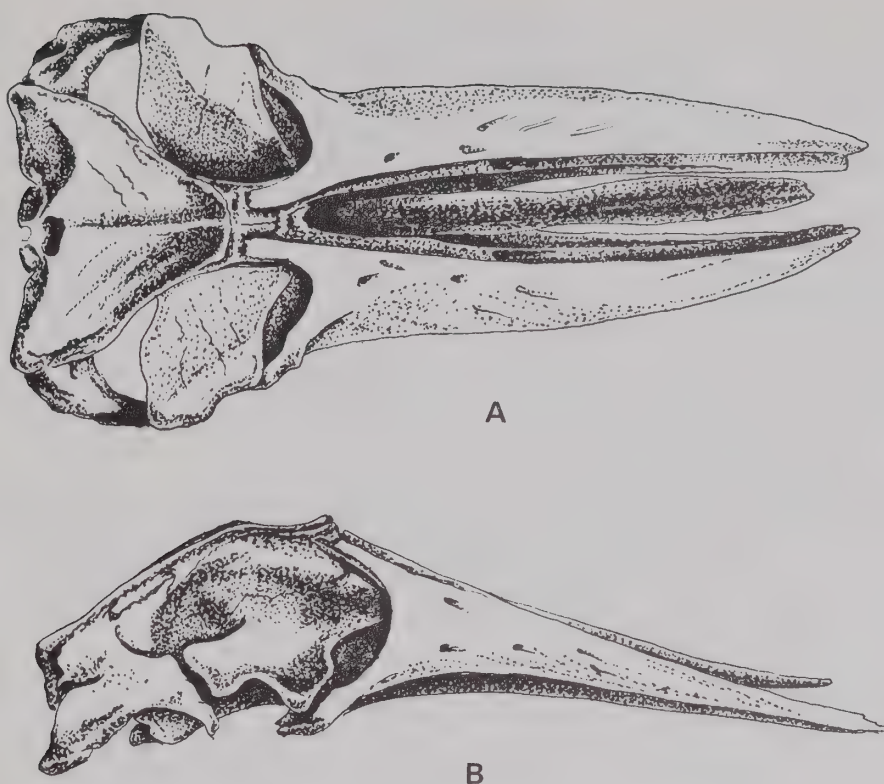


Fig. 80 Showing skull of *Balaenoptera physalus*.  
A. Dorsal view.  
B. Lateral view.

**Biology:** The gestation period of this species is believed to be  $11\frac{1}{2}$  months with a single young normally being born, which measures 6m (20ft) at birth. It is believed that the young are only produced every second year in the Baleen Whales and that both the Fin and Blue Whales reach maturity at between four and seven years of age.

The newly born calves are suckled by the female floating near the surface and turning on her side so that the nipples are above water and the baby can breathe while suckling. The teats lie within two parallel slits each side of the reproductive opening and the milk is actually pumped by contraction of the mother's body muscles into the mouth of the calf at a very rapid rate so that suckling does not take long. After the young whale grows a bit older, it is apparently able to suckle under water without the mother having to come to the surface. Weaning takes place at about the seventh month at which time the young are almost two-thirds the size of the adult.

As might be expected from their streamlined shape, they are swift and graceful swimmers and when frightened or pursued have attained speeds of up to 48 km/hr (26 knots) (Walker et al., 1964). They propel themselves solely by vertical up and down movements of their tail flukes.

When feeding quietly or not pursued, they generally make one deep dive lasting 10–20min and thereafter three or four shallow dives each lasting 12–15sec, during which time air is replenished in the lungs. The spouting of Baleen Whales is actually the exhalation produced just at the moment the blowholes or nostrils break the surface. This is clearly visible as condensed water vapour as the warm damp air from its lungs comes into contact with the cold atmospheric air.

#### BALAENOPTERA MUSCULUS

*Balaenoptera musculus* Linnaeus, 1758; Great Blue Whale or Sulphur Bottomed Whale.

Synonym *Sibbaldus musculus* Linnaeus, 1758.

**Description:** Unlike the Fin Whale, this species has a darker blue-grey belly and its dorsal fin is relatively small and inconspicuous. It is dark blue-grey all over, blotched with paler green-grey. In antarctic waters the belly is often covered with a sulphur coloured film of diatoms (microscopic algae) and this yellow colour has given rise to its alternative common name Sulphur Bottomed Whale.

Its general shape is relatively longer and slimmer than any of the other Baleen Whales, and as is well known, it is the largest of whale species and indeed the largest animal ever known to have existed on earth. Females are bigger than males, and before the population became decimated females measuring over 27.45m (90ft) in length were not uncommon, though the average adult female size is considered to be around 23.5m (77ft) and males are generally below 22.75m (75ft) in length. It has been calculated that an adult female Blue Whale weighs 153,000kg (150 tons).

The head is relatively larger than that of the Fin Whale with the upper jaws forming a wide V shape when viewed from above. There are 80 to 100 ventral grooves from the jaw to the chest region. The baleen plates including their hairy fringes are solidly black and this is an important identifying point when stranded remains are not accessible to be seen by competent zoologists until after the carcass has disintegrated.



**Distribution and Status:** Normally the Blue Whale is not considered as entering warmer tropical waters even during the breeding season. However in June 1967 a Blue Whale was stranded near Pasni on the Mekran coast, near an area of coastline which is actually well inhabited. Its skeleton is now preserved in the museum of the Zoological Survey at Karachi. The ramus of its lower jaw measures 5.5m (18ft) and the total skeletal length is 21.35m (70ft). It is not a complete skeleton as many ribs were taken by the local people for house construction, their shape and size being ideal for roof-trusses. In the Sind Gazetteer, K. R. Eates reports two occasions in which the Blue Whale has come into collision with steamers sailing between Karachi and Bombay and there are other scattered records for the stranding of this species, e.g. near Bombay (Kinneir, 1911) so it would appear that it regularly occurred even in coastal waters of the Indian Ocean when it was more plentiful.

The Blue Whale because of its massive bulk was the richest source of oil and hunted more ruthlessly than the other whale species frequenting antarctic waters. After the development of mobile factory ships the intensity of hunting increased with an estimated 29,400 individuals being killed in the antarctic alone in the year 1931 (Small, 1971). Although the percentage of Blue Whales in the annual catches of the whaling fleets thereafter declined drastically and progressively because of their increasing scarcity, it was not until 1963 that the species was declared protected from hunting in the Antarctic under the International Whaling Agreement. It is now doubtful whether the remnant population of this giant will ever survive, let alone recover its numbers. Surely the story of the decimation of the world population of the largest mammal known to have existed, is a sad testament to mankind's greed and short-sightedness.

**Biology:** Much the same as for the Common Rorqual though it is a less gregarious species and is never encountered in schools. Its estimated gestation period is 11 months. Newly-born young are larger in this species, measuring about 7m (23ft) in length at birth and by the time they are weaned at about seven months of age, they measure 15m (50ft).

Despite its great size the Blue Whale has been reported capable of swimming at speeds of 26.5 km/hr (14 knots) when pursued.

#### Genus MEGAPTERA Gray, 1846

##### Key to the Genus and Species MEGAPTERA

Pectoral flippers large, one-third of head and body length. Only 15 to 25 longitudinal grooves in region of throat. Body rather stocky and not streamlined.

... *Megaptera novaeangliae*

#### MEGAPTERA NOVAEANGLIAE

*Megaptera novaeangliae* Borowski, 1781; The Humpback Whale.

The Humpback Whale is one of the smaller Baleen Whales and it has a comparatively short broad body, 11–16m (36–52ft) in length. It has enormous flippers measuring up to 5m (17–18ft) in length and 10–25 grooves on the throat and chest region. The Humpback Whale is believed to stick to very deep water though they also migrate to tropical waters during the breeding season. A specimen is on record as having been stranded on the coast of Baluchistan in 1873 (*JBNHS*, Vol.

47, No. 4). Probably it still occurs occasionally in Pakistan coastal waters.

#### SUBORDER ODONTOCETI

##### FAMILY PLATANISTIDAE – RIVER DOLPHINS

Consisting of four genera of Dolphins, *Platanista* from the Indo-Pakistan subcontinent with two species (see below), and three monotypic genera largely adapted to a riverine freshwater existence in tropical or subtropical countries. *Lipotes* and *Inia* species inhabit rivers in China and South America, whilst *Pontoporia* is a marine species found off the Uruguayan coast.

##### Key to Family PLATANISTIDAE and Genus PLATANISTA

Small Dolphins (under 3m total body length) with narrow elongated rostrum and a small ridge-like dorsal fin.

##### Genus PLATANISTA Wagler, 1830

##### Key to Species of PLATANISTA occurring in Pakistan Coastal Waters

Head and body length 1.75–2.75m. Dorsal fin very small. Rostrum very narrow with 21 to 30 teeth each side of jaw. Paddles or pectoral flippers very broad and cut off square distally.

... *Platanista indi*

#### PLATANISTA INDI

*Platanista indi* Blyth, 1859; Indus Dolphin (see Illustration 91).

**Taxonomy:** Recent studies by Dr. George Pilleri (1970C) have shown that the original description of *Platanista gangetica* should be attributed to the Scottish botanist Roxburgh in 1801 and not to Lebeck. Furthermore studies of differences in the skulls of Dolphins from the Indus river system and the Ganges and Brahmaputra revealed that the two populations were anatomically distinct with the nasal bones having a much more prominent crest in the Indus Dolphin. The form of the maxillary crests also varies (Pilleri and Gehr, 1971B). Therefore the Indus Dolphin is specifically distinct and the original name *Platanista indi* given by Edward Blyth in describing this dolphin in 1859 should stand and is used here.

**Description:** It is probably one of the most specialized of the world's freshwater dolphins, being confined to fluvial not tidal water, which is heavily turbid and silt laden. In outline it is a typical dolphin, with a sleek fusiform body, the caudal region being laterally compressed and very slim. It differs from most other dolphins in the broad spade shaped flippers and the rostrum or beak which is relatively long and very slender. The forehead is high rounded and domed with a suggestion of a neck or constriction just anterior to the pectoral flippers which is lacking in most marine dolphins. The rostrum is very compressed laterally, long and slender, being slightly swollen in the distal portion. There are two rows of non-differentiated conical teeth in both jaws which are backward curving and interlock when the mouth is closed. These teeth are longest in the distal part where they may

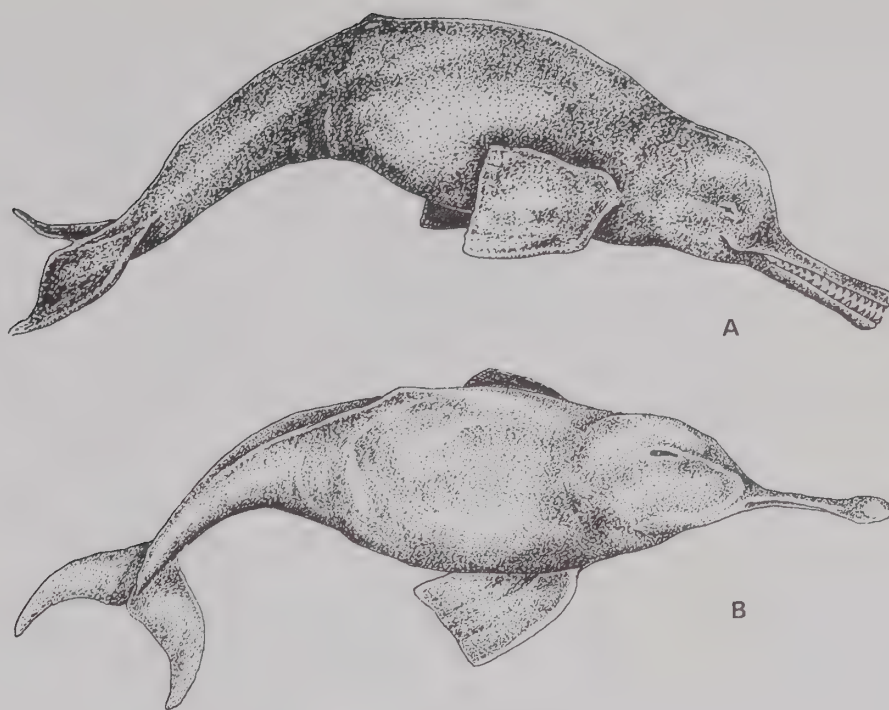


Illustration 91 *Platanista indi*: Indus Dolphin. (Based on photographs in the possession of Dr. G. Pilleri and Mr. T. Robertson of captive specimens secured in November, Indus River above Sukkur.)

A. Lateral view.

B. Dorsal view showing spiracle open to exhale.

measure up to 32mm (1¼ in.) in length. They become progressively shorter and smaller as they proceed towards the proximal part of the jaw. Adults have 34 teeth and immature specimens were found to have 30 to 36 teeth (Pilleri and Gihir, 1971B). There is sexual dimorphism in this Dolphin with the males having a markedly shorter rostrum and generally being slightly smaller in size.

In colour this dolphin is pinkish or purplish grey-brown, being only slightly paler ventrally. Some species are a darker leaden-grey colour and the tail flukes are usually more of a grey colour. The skin is soft and satiny to the touch in surprising contrast to the harsh granulated skin of a shark (*Galeoidae* spp.) or the slippery feel of true fishes. The skin is delicate and cuts easily and has no mucous secretion. The blowhole also differs from most dolphins' in shape. It consists of a single longitudinal slit in the highest part of the crown (see Illustration 91). There is a deep fold just above the corner of the mouth, in which the tiny vestigial eye is just visible. The dorsal fin is hardly developed being no more than a triangular ridge (see Fig. 81). The pectoral flippers are set rather far back and are comparatively broad and spade shaped being square cut in their distal portion and not elliptical or arcuate as in all the marine dolphins. This is probably an ecological adaptation to its peculiar method of swimming on the side.

A specimen of *P. indi* from the Indus described by J. A. Murray was 1.37m (4½ ft) long with pectoral fins 190mm (7½ in.) long and 127mm (5 in.) broad. The rostrum measured 267mm (10½ in.) (Murray, 1884). An immature female captured in 1969 by Dr. Pilleri was 1.23m (48½ in.) long (measured from the notch in the middle of the tail to the nose tip), and it weighed 18kg (39½ lb). Another, male, measured 1.23m in length and weighed 21kg. The flippers measured 170–180mm in length and 110mm broad. The rostrum of the biggest male

measured 130mm and that of the biggest female 140mm. The tail width varied from 260 to 290mm (Pilleri, 1970B). Prater (1965) states that adult females weigh up to 125kg and measure 2.3–2.6m but it is probable that these measurements refer only to the larger *P. gangetica* and even so are too high. The heaviest of six specimens of *P. gangetica* from Assam was 83kg and this was a pregnant female (Pilleri, 1970B).

**Distribution and Status:** An exclusively fluvial species, it is confined to silt-laden flowing rivers, avoiding the narrow turbulent reaches where such rivers enter foothill country or flow between shingle banks. Moreover there is no evidence that they ever entered tidal waters in the Indus and they are probably sensitive to salinity though *P. gangetica* during high floods of the monsoon season does descend to tidal waters (Prater, 1965).

The construction of irrigation barrages has divided up the dolphin population in the Indus since they cannot pass through these irrigation headworks. Development of extensive irrigation systems has drastically reduced the flow of water in the Indus also and in the winter months the tributary rivers such as the Ravi, Sutlej and even the Indus downstream of the Kotri Barrage virtually dry up.

Undoubtedly the total population of *P. indi* in Pakistan is much reduced in the last two or three decades and is now in real danger of extinction. Probably the total number is well below 200 individuals. None occur downstream of Kotri Barrage or upstream of Chashma Barrage in the Indus. A very few must survive between Kotri and Sukkur Barrages because one individual was sighted by me in 1972 near Rajari Forest Reserve. The main population is now between Sukkur and Guddu Barrages, and even here Dr. Pilleri in February 1972 estimated the population to be not more than 70–80 (Pilleri,





Distribution Map 117 Indus Dolphin or Su-Su.

1972B). Recent sightings confirm that a few may survive in the Chenab between Panjnad and Trimmu Barrages as Dolphins have been seen in the early 1970s at all these places. A small herd still exists on the Sutlej River in the pondstream above the Suleimanki Barrage (Major S. A. Khan, pers. comm., 1972), but it is unlikely that this small isolated population can long survive. Since it is a species unique to this region and of great zoological interest it is hoped that some measures will be taken to preserve and protect this dolphin before it is too late.

**Biology:** Living in such turbid water it is an especially difficult mammal to study and little has been recorded about its habits until recent successful attempts to transport live dolphins to aquaria in the USA and Switzerland (Herald, 1969 and Pilleri, 1970A).

It is apparently quite gregarious, as schools of up to 10 individuals have been observed circling around and swimming together in the Indus some 20 miles above Sukkur (Pilleri, 1970A). But due to its restricted environment they are not normally highly social and it is more usual to observe solitary individuals or pairs. They occasionally leap partially out of the water or expose their whole head and rostrum, but when normally rising to breathe they only expose the top part of their heads and back. A pair of dolphins watched below Chashma appeared to rise to breathe every 6 to 10 seconds two to four times in succession and then to dive deeply for seven to eight minutes.

Observations by Dr. Pilleri on a captive specimen have revealed that they never rest on the bottom as do some freshwater cetaceans such as *Inia geoffrensis*. Instead they remain perpetually in motion, swimming normally on their side and close to the bottom. Furthermore they continuously use echo location, emitting clicking noises of very high frequency. Other dolphins generally employ such sonar only intermittently when hunting or encountering strange obstacles. They appear to be most active in the early part of the night and to do most of their feeding at this time (Pilleri et al., 1971A). In

the Indus River they often frequent shallow water and enter side channels of the main river to hunt and these are regions typically inhabited by Catfish or 'Mullee' (*Wallagonia attu*). Since this is the most abundant species in the Indus upstream of Taunsa Barrage (Khan, 1946), it can be presumed that this fish enters into the dolphin's diet, as well probably as *Cirrhinus mrigala* and *Mystus aor*, which are both plentiful in the Indus. They also probably feed on the freshwater crayfish *Macrobrachium malcolmsonii* which is fairly plentiful through the Indus and which often grows to 12cm head and body length. Because of their habit of swimming on their sides, the lower spade shaped flippers can be used to propel their bodies through shallow water and they have been observed entering and swimming in channels where the water depth was only 20cm (Pilleri, 1970A). At Berne captive Indus Dolphins only snapped at live fish, rejecting dead fish. Later in captivity they also accepted dead fish. Once seized, the fish, being held in the distal third of the rostrum, is invariably swallowed head first. In order to breathe, as side swimmers, they rotate their bodies through 90° and come up to the surface to inhale in the normal dolphin manner (Pilleri, 1970B).

Sonar or echo location is especially well developed in this species because its eyes have become non-functional, lacking any lens, though there is an extremely small optic nerve (Pilleri, 1971A). Thus they never cease to emit continuous sound pulses. These have been found to have the frequency of 1–90 per second and these sound bursts are emitted irregularly at intervals of 1–60sec. Other marine dolphins in captivity, once they memorized the dimensions of their tanks, ceased emitting sound pulses but *P. indi* never breaks this habit (Pilleri et al., 1971). This system of echo location, as in the insectivorous *Chiroptera*, therefore enables *P. indi* to hunt its prey successfully despite the fact that it is probably blind. It is significant that the enlarged front part of the dolphin's brain is protected by two long maxillary crests not found in any other cetacean skull (see Fig. 82). Perhaps these shields of bone also have a relation to this acoustic function.

It is believed that the female normally gives birth to one calf after eight to nine months' gestation (Anderson, 1878). A very small dead specimen measuring about 900mm was seen by me in early November above Panjnad and another immature (dead) specimen drowned in a fisherman's net at Trimmu in late September. These observations would seem to corroborate breeding in the early summer months when snow melt produces more water in the rivers. Local fishermen record mating as taking place in March with a gestation period of a full 12 months. Two or three different males are reported to circle around during copulation and the female subsequently mates with one or two other males (Pilleri, 1972B). Newly-born young are recorded as weighing 7kg at birth and measuring 450mm (Walker et al., 1964). A captive male at Berne grew 400mm in length in two years (Pilleri, pers. comm.).

Nothing is known about the longevity of this dolphin but based on studies of other *Odontoceti* it may well be up to 20 years. They are principally preyed upon by man and being fish eaters are disliked by the 'Mohannas' or professional fishermen, and are often hunted and killed. In earlier times the Mohannas used trained otters to decoy the dolphin, which would be attracted by the sounds of the otters chasing fish and rush to the scene (Eates, *Sind Gazetteer*, 1968). The dolphins are then ensnared in strong bell-shaped nets submerged in the river by the Sindi fisherfolk. Before the development of barrages across the Indus and reduction in the dolphin population these Mohannas used to trap dolphins in order to extract their oil, which was used for lighting their lamps as

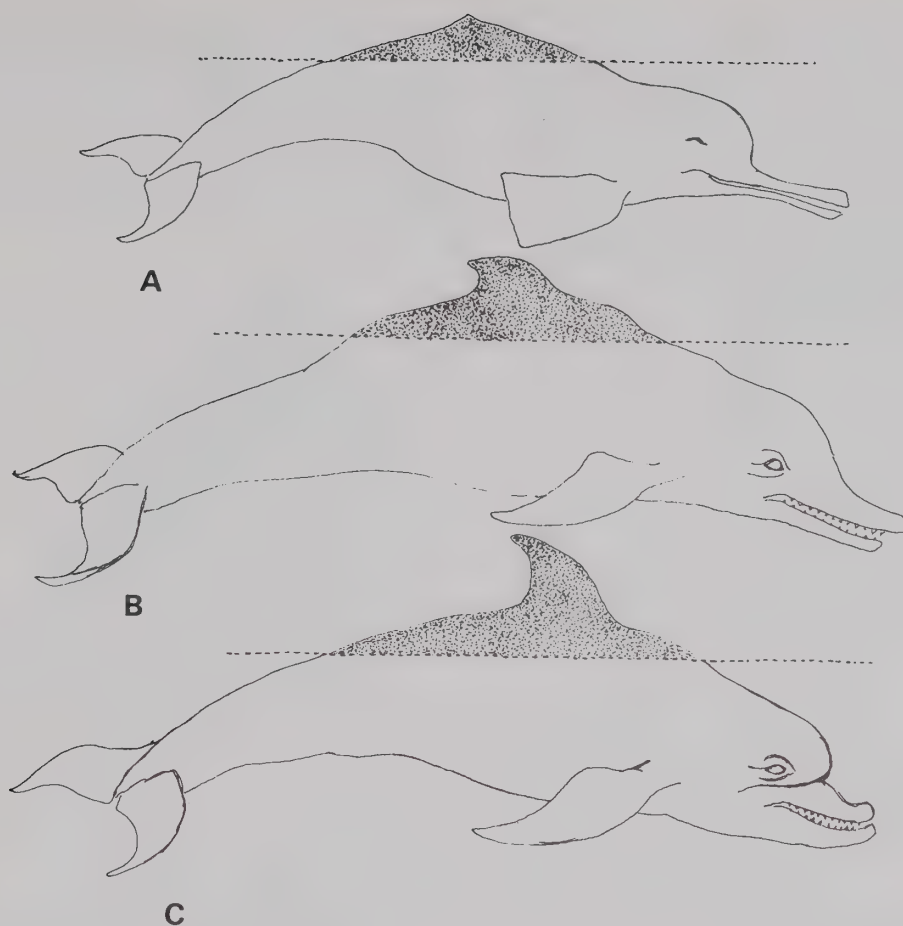


Fig. 81 Showing comparison between typical silhouettes of Dolphin species, exposed above water, after respiration. Shaded portion indicates the amount of body which is normally exposed above water immediately after breathing.

- A. *Platanista indi*. Note very small dorsal fin.
- B. *Sousa plumbea*. Note characteristic humped outline of back.
- C. *Tursiops aduncus*. Note prominent dorsal fin.



Fig. 82 Showing lateral view of skull of *Platanista indi*. Note the peculiar maxillary crests of bone protecting the forefront of the head.



well as a lubricating agent (Murray, 1884B). It is still considered beneficial in treating muscular pains and rheumatism. Probably in former times the Gavian Crocodile (*Gavialis gangeticus*) may have succeeded in capturing immature Susu but it has become very rare in the Indus, and professional fishing tribes have undoubtedly been the principal predator on this dolphin.

A nematode (stomach parasite) was found in specimens captured above Sukkur. It was 40–70mm in body length and was identified as *Contracaecum lobulatum* (Pilleri, 1970B), being the same species of nematode as found in *P. gangetica*.

#### FAMILY PHYSETERIDAE — SPERM WHALE, PYGMY SPERM WHALE

Comprising only two species the Sperm Whale and the Pygmy Sperm Whale. They are characterized by very narrow lower jaws bearing teeth and with no teeth in the rather high and square ended upper jaw or snout. The blowhole is located on the left side of the head. They inhabit all oceans and are normally gregarious, travelling in small herds.

##### Key to the Family PHYSETERIDAE

Single blowhole situated on left side of head. Skull asymmetrically distorted with 18–60 strong conical teeth embedded in a narrow lower jaw. Upper jaw square-shaped in profile and projecting beyond lower jaw.

##### Genus KOGIA Gray, 1846

##### Key to Species of KOGIA occurring in Pakistan Coastal Waters

Small dorsal fin. Body 2.75–4m long. Colour dark grey and paler grey ventrally. Nine to 15 sharp conical teeth in lower jaw.

... *Kogia breviceps*

##### KOGIA BREVICEPS

*Kogia breviceps* Blainville, 1838; Pygmy Sperm Whale (see Illustration 92 and Fig. 83).

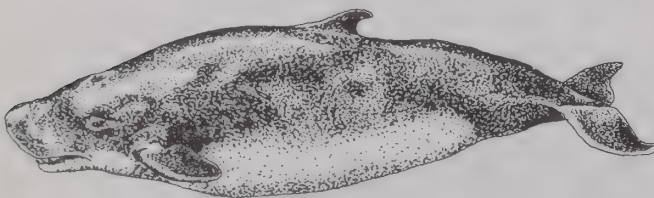


Illustration 92 *Kogia breviceps*: Pygmy Sperm Whale. (Based on photographs Smithsonian National Museum, USA, of Atlantic Ocean origin.)

**Description:** The Pygmy Sperm Whale rarely exceeds 3.5m in length. It is a blackish-blue colour with a paler grey belly. It has a comparatively large and blunt head, though this is much smaller in relation to the rest of its body than is the case with the Sperm Whale (*Physeter catodon*). Its narrow lower jaw contains a row of 9–15 simple conical teeth on each side. Generally there are no visible teeth at all in the

upper jaw though in the skeleton a rudimentary pair of teeth can be seen in the upper jaw. The dorsal fin is small but fairly prominent and the flippers are short and roughly triangular in shape. The top of the head protrudes slightly beyond the lower jaw (see Fig. 83). The tail fluke is notched and about 610mm broad. Males are usually larger than females and may weigh over 300kg, with females around 180kg.

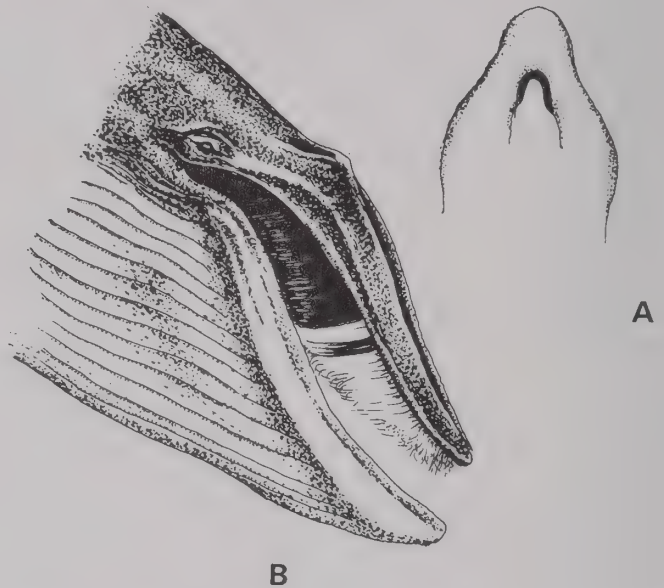


Fig. 83 Showing heads of whales:

- A. Ventral view of head of *Kogia breviceps* showing narrow and much shorter lower jaw.
- B. Lateral view head of *Balaenoptera physalus*, Fin Whale showing asymmetrical pattern of black and horn coloured or whitish baleen plates in right side of mouth.

**Distribution and Status:** It has occasionally been observed quite close inshore around the mouth of the Indus as well as in the Bay of Oman south east of Gwadar. After the end of the monsoon season these Mekran coastal bays are important upwelling centres with deeper subsurface water bringing fresh fertility to the coastal waters. This produces rich feeding conditions for many species of fish which in turn attracts various Toothed Whale species. There are records of stranding of this species around the coast of South India though there is no authentic record of any stranding on the coast of Pakistan. The species was, however, well known to the late Dr. Ranjha, Director of the Zoological Survey.

The small toothed whale is thought to be uncommon wherever it occurs as it has hardly ever been captured alive nor found stranded in any numbers, though there is evidence that it is distributed throughout the Pacific and Atlantic Oceans and extending into both hemispheres.

**Biology:** This small toothed whale is generally considered an inhabitant of deep oceans. There is some evidence that it is a gregarious species. It is a slow swimmer and is thought to feed mostly upon Cuttlefish (*Cephalopods*). Since these creatures are mostly found in deep water the Pygmy Sperm Whale is believed to be capable of deep dives and of remaining for considerable periods under water. Pregnant females have been found from December to April indicating an extended breeding season. There is a record of a 3m long female giving birth to a 1.75m calf in November when it was stranded. The

calf weighed 80 kg (Walker et al., 1964). The gestation period is believed to be nine months and females mate every alternate year, the calf remaining with its mother for about one year.

#### FAMILY PHOCAENIDAE – PORPOISE, FINLESS BLACK PORPOISE

This family comprises two genera of rather small sized species showing a preference for coastal and estuarine waters. They have a number of small spade shaped teeth in both jaws and rather bluntly rounded heads without an elongated or pronounced snout and are generally referred to as porpoises.

#### Genus NEOMERIS Gray, 1846

##### Key to Species of NEOMERIS occurring in Pakistan Coastal Waters

No dorsal fin present. Very small size 1.5m long. Body all purplish-black with few pinkish-grey spots around mouth and throat. Fifteen to 21 spade-shaped or spatulate teeth.

... *Neomeris phocaenoides*

#### NEOMERIS PHOCAENOIDES

*Neomeris phocaenoides* G. Cuvier, 1829; Little Indian Porpoise or Black Finless Porpoise (see Illustration 93).

**Description:** Lacking any pronounced beak or rostrum, it resembles the Common Harbour Porpoise in head shape and especially the skull (see Fig. 84) but it is distinguished from the Genus *Phocaena* to which the Harbour Porpoise belongs by the complete absence of any dorsal fin. It is thus fairly easy to recognize when it comes to the surface to breathe. Moreover, they are quite small in size, the total body length rarely exceeding 1.55m in females, and 1.4m in the slightly smaller males. In the water the body colour appears uniformly purplish-black with the ventrum being equally dark. Only the lower jaw and throat region is a paler pinkish-grey and the region around the mouth may also be paler pinkish-grey. When observed out of the water the skin is a purplish-grey colour.

The head is bluntly rounded without any protrusion of the jaws. There is only a slight suggestion of a neck or constriction posterior to the blowhole (spiracle) which is crescentic. The pectoral flippers are relatively small and elliptical in shape. The

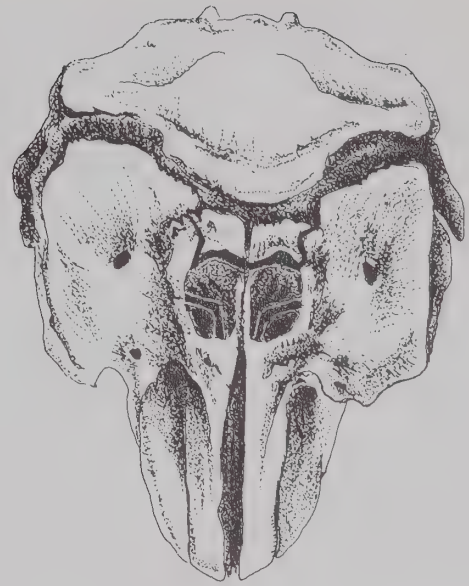


Fig. 84 Showing dorsal view of skull of *Neomeris phocaenoides*.

caudal region is slim and much compressed laterally. In the middle region of the back in the place which would normally be occupied by the dorsal fin, there is an area of skin covered by small hard tubercles. This armoured skin area narrows to a slender point towards the caudal region. (These tubercles do not occur on the flanks as indicated by Prater, 1965.) The eyes appear well developed according to the size and appearance of the optic nerve (Pilleri, 1972A).

An adult female captured off Karachi harbour weighed 27kg and measured 1.275m in length, with a maximum girth of 780mm. It was pregnant. The tail flukes were 380mm broad and the pectoral flippers 230mm long (Murray, 1884A). As in all the toothed whales, the female has two mammae located in longitudinal slits in the inguinal region of the belly. Six specimens collected by Dr. Pilleri from the mouth of the Indus varied from 38.1kg for a large female to 24.5kg for a small male (Pilleri, 1972A). The teeth of this species are not conical but tend to be flattened apically and somewhat spatulate. They number 16 to 20 in each jaw (Keswal, 1886).

**Distribution and Status:** *Neomeris* can be seen from late September up to April all along the Mekran Coast, frequenting the mangrove creeks and inlets. It has been sighted around Sonmiani Hor, in Las Belas and the estuary of the Hingol



Illustration 93 *Neomeris phocaenoides*: Finless Black Porpoise. (Based on photographs fresh killed specimens in possession of Dr. G. Pilleri from Sonmiani, Mekran coast.)



River in the Mekran. In the Indus mouth they frequent Kudi, Mull, Khai and Dubla creeks in the mouth of the Indus (Pilleri, 1972A). Mull creek is about four fathoms deep. Two species of dolphins were observed in Chahbar Bay in the winter of 1971, which is just west of the Pakistan border with Iran and it is almost certain that these included *Neomeris*.

Elsewhere it has been recorded up to the Persian Gulf and down the west coast of India to Kerala. It also occurs in estuarine regions in China where it is represented by a special race *Neomeris phocaenoides asiae-orientalis* (Pilleri and Gihir, 1972). It also occurs around Korea and the Straits of Malacca, Borneo and Indonesia (J. Harrison, 1966 and Ellerman and Morrison-Scott, 1951). Though it was described from the Cape region of South Africa by Dussumier this record seems out of its usual range and though the original specimen is in the Paris Museum its location may have been wrongly described (Pilleri, 1972A).

In the monsoon months it appears to enter deeper water and to be more pelagic.

Due to the increase in use of motorized fishing vessels and fishing activity in the Indus mouth, the Little Indian Porpoise is reported by local fishermen to have declined considerably in numbers. It is however, still easily sighted in winter around the Indus mouth and would not appear to be as endangered as *Platanista indi*.



*Neomeris phocaenoides* Regular sightings  
Probable distribution

Distribution Map 118 Black Finless Porpoise or Little Indian Porpoise.

The Indo-Pakistan population appears to belong to a distinct population *Neomeris phocaenoides phocaenoides* Cuvier, 1829 (Pilleri, in lit.), separable from the Chinese and Pacific population.

**Biology:** In the water *Neomeris* appears relatively sluggish and when rising to breathe, it often exposes only the top part of its head and back in a rather leisurely roll. Often they emit sounds as they come up to exhale and these are audible to human beings from a distance of several metres.

They do not seem to be as gregarious as other estuarine species and generally females are observed with half-grown offspring and males singly. They can occasionally be seen

swimming or feeding in the vicinity of *Sotalia (Sousa) plumbea* but no schools of *Neomeris* have ever been observed or recorded whereas *Sotalia* and *Platanista* are often encountered in parties of 3 to 6 individuals.

*Neomeris* appears to feed on various small squids (*Sepia* spp.), shrimps, prawns (*Penaeus indicus*) and small fish (unidentified). The beaks of squids and bones of cuttlefish have been found in their stomachs (Keswal, 1886 and Pilleri, 1972A). I have observed a slender-billed Gull (*Larus genei*) follow closely a feeding *Neomeris* in order to seize any food such as severed portions of squid tentacles which float to the surface as the porpoise comes up to breathe. The gull remained swimming during this time and often contrived to be within less than half a metre from where the porpoise surfaced without any sign of alarm — a nice example of a rather unusual symbiotic relationship. Local fishermen state that *Neomeris* sometimes remains feeding in small river arms and pools cut off by the receding tide where they are not disturbed. However during the summer months and onset of the monsoon they appear to migrate away from coastal regions and do not reappear until the following October. The colder waters blown in shore at the end of the monsoon produce particularly favourable conditions for prawns and it is during October and November that *Neomeris* will be seen most frequently in the mangrove creeks.

Little is known about their breeding biology but a pregnant female was captured in late August or early September (Keswal, 1886) and females with small young can often be observed in October and November. Probably the young stay with their mothers nine to 12 months and continue to suckle all this time. A female with a three-quarters grown young was captured in mid November in the mouth of the Indus (Pilleri, 1972A).

#### FAMILY DELPHINIDAE — DOLPHINS

This family comprises 18 genera inhabiting all the oceans of the world and most of these are given the common name dolphin. They are generally relatively small Cetaceans with beak-like snouts, and a well-developed dorsal fin. They are typically very agile and speedy.

#### Key to the Family DELPHINIDAE

Usually 1½–5m long with a single crescentic blowhole (spiracle) situated well back from the tip of the snout and a prominent dorsal fin. Usually numerous functional teeth in both jaws.

#### Genus DELPHINUS Linnaeus, 1758

There are three species in this genus which are generally found in warmer tropical waters. They are all gregarious species, and very swift swimmers.

#### Key to the Genus DELPHINUS

Having a clearly-defined beak or bottle-nose with 40–50 teeth on both sides of each jaw. Head and body length 1.5–2.5m. Dorsal fin arcuate in outline and about 0.3m high. Ventrum usually contrasting paler colour with longitudinal dark stripes along flank.

#### Key to the Pakistan Species of DELPHINUS

Fifty-four to 58 teeth in each side of upper and lower jaws.

Upper body dark grey and belly white with longitudinal bands of grey and yellow along the flanks.

... *Delphinus capensis*

### DELPHINUS CAPENSIS

*Delphinus capensis* Gray, 1828; Cape Dolphin.

**Description:** Very similar in appearance to the Common Dolphin, it has a prominent arcuate dorsal fin measuring about 0.3m in height. The belly is coloured white and the back and upper part of the body varies from black to grey with longitudinal bands of grey and yellow along its sides. The beak or rostrum is relatively slender and pointed and divided from the domed forehead by a dark line which encircles the eye. The eye is well developed and it would appear that this dolphin has comparatively good vision. The breathing hole consists of a crescentic slit in the top of the head situated in line with the eyes. The lower jaw extends slightly beyond the upper and there are numerous very sharp pointed almost needle-like teeth varying in number from 54 to 58 in each jaw. The Common Dolphin (*Delphinus delphis*) has only 40–50 pairs of teeth.

Five specimens secured in November 1971 off Cape Monze near Karachi varied in total body length from 1.51m up to 2.56. The largest male weighed 136.8kg (Pilleri, 1972A).

**Distribution and Status:** This is normally considered a pelagic species but schools of porpoises occasionally feed close into shore.

Insufficient reliable evidence can be obtained to indicate anything about the status of *Delphinus* species of dolphin in the coastal waters of Pakistan but from second-hand evidence of local fishermen it would appear to be sometimes entirely absent from coastal waters and not sighted so regularly as the Red Sea Bottle-nosed Dolphin.

Without examination of secured specimens it is impossible to separate free swimming *Delphinus capensis* from *Delphinus delphis*, the Common Dolphin. Due to its larger number of teeth Dr. G. Pilleri assigns the dolphin species from Karachi waters to *Delphinus tropicalis* (Van Bree) which may be synonymous with *D. dussumieri* (Blanford, 1891 and Pilleri, 1972A). Lacking sufficient comparative specimens or skulls, Ellerman and Morrison-Scott (1951), have provisionally placed *D. dussumieri* with *D. capensis*.

**Biology:** This is normally considered to be a pelagic species but schools occasionally feed close inshore. They are fish eaters according to stomach contents examined (Pilleri, 1972A). They probably feed mostly off young sharks, tuna and pomfret which are common off the Mekran coast. They are gregarious, often seen in huge schools and they are evidently very swift swimmers and apparently seem to enjoy crossing in front of ships and leaping out of the water.

The Common Dolphin normally bears young from mid winter to summer after a gestation period of nine months but nothing is known about the breeding of this species.

Genus **SOTALIA (SOUSA)** Gray, 1866

### Key to Genus and Pakistan Species of SOUSA

With a narrow constricted beak or rostrum and over 34 pairs of teeth in each jaw. Body uniformly dark leaden coloured without ventrum being noticeably paler and with dorsal fin

situated on a very characteristic raised 'hump'. Pectoral flippers falcate in outline.

... *Sousa plumbea*

### SOUSA PLUMBEA

*Sousa plumbea* Gray, 1866; Plumbeous Dolphin or Red Sea Dolphin (see Illustration 94).

Synonym *Sotalia plumbea* Cuvier, 1829.

**Taxonomy:** According to recent studies by Dr. Fraser and Dr. Kellogg *S. plumbea* and *S. lentiginosa* should be placed in a separate genus *Sousa* (Pilleri, in lit.). See also Walker et al. (1964) and J. Harrison (1966).

**Description:** The Plumbeous Dolphin is superficially rather like the Indus freshwater dolphin (*Platanista*), having a relatively long slender and conspicuous rostrum with an even coloured leaden grey body and no markedly paler skin on the belly.

It is however, considerably bigger than the Indus Dolphin, with a more prominent elongated dorsal fin and a very characteristic humped dorsal outline (see Fig. 81). A more detailed examination reveals that the rostrum is relatively shorter than that of *Platanista indi*, and there is only a slight constriction of the neck region. The pectoral flippers are longer and slimmer and pointed distally in contrast to the square-cut flippers of *P. indi*. The skull of *S. plumbea* also lacks any maxillary crests and has widely separated pterygoid bones behind the palate, but reveals a large and well developed brain area (Pilleri, pers. comm.). There are usually 36 teeth in both upper and lower jaws and the rostrum is roughly one-sixth of of the total head and body length (Prater, 1965).

In the water they look a purplish-grey or pinkish-grey colour with the belly slightly paler. Adults measure 2.5–2.75m in body length and may weight up to 550kg.

**Distribution and Status:** Frequents the same mangrove inlets and coastal creeks as *Neomeris* and seems to be a coastal feeding species. It is however less adapted to feeding in very shallow water and like the Finless Porpoise appears to migrate to deeper open water during the summer months. I have seen it in narrow creeks at least 10 miles from the open sea in the Indus Mouth.

Judging from the frequency of sightings it is much more numerous in mangrove creeks than *Neomeris*. It extends throughout the Mekran coastal region and has been observed in Sonmeani Bay as well as near Gwadar.

Elsewhere it extends to the Red Sea, Persian Gulf, Gulf of Aden and Suez Canal. It is also known from the Bay of Bengal and as far south as Madras and all the coast of Sarawak and south east China seas (J. Harrison, 1966 and Blanford, 1891). Inadequate museum material prevents full systematic study of the different populations, but one authority has indicated that the world population of *Sousa* (*Sotalia*) may be no more than five subspecies, all closely related, and that the West African, Indo-Pacific, Eastern Atlantic tropical, Chinese and Bornean forms should be considered as allopatric populations of the same superspecies (Fraser, 1966).

**Biology:** More social than *Neomeris* it is often seen in parties of four to six, and its movements in and out of the water indicate that it can swim quite swiftly and that it is not so sluggish as the small Finless Black Porpoise. Probably they feed largely upon fish and their narrow elongated rostrum



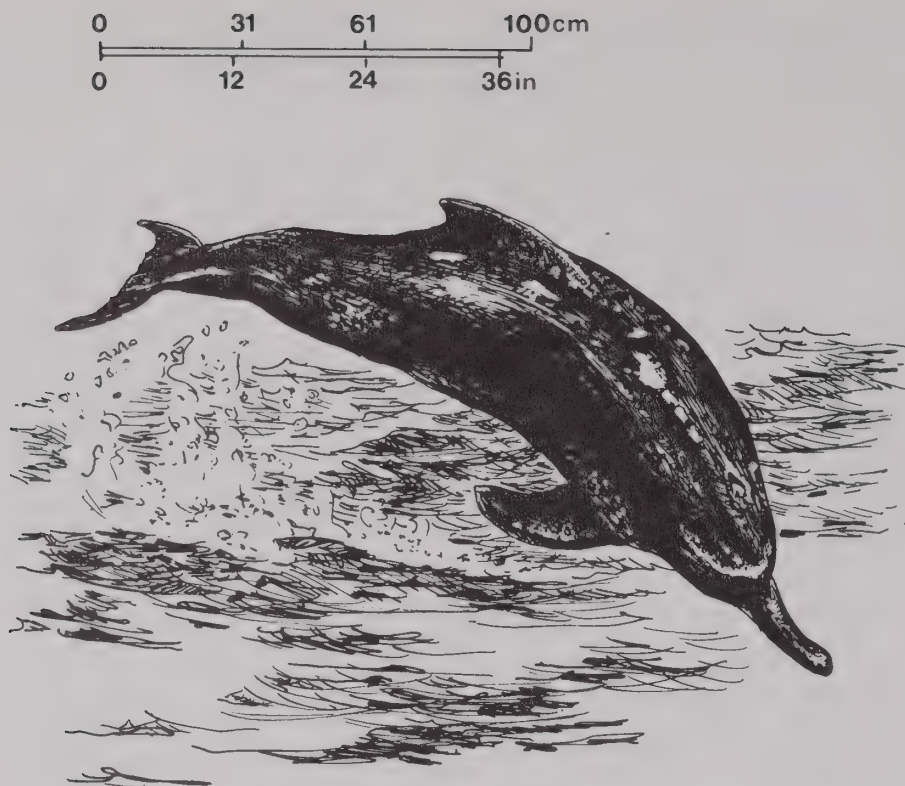


Illustration 94 *Sousa plumbea*: Plumbeous Dolphin. (Based on photographs of free wild specimens, observed February and November, Indus Mouth.)

would certainly fit them for catching fish but their preference for coastal creeks and inlets indicates that prawns and cuttlefish may form a part of their preferred diet.

Observations in the Indus mouth both in November and February indicate that they normally consort in small family groups or pods of two to eight individuals and that they seem to enjoy social contact and to be relatively playful. In both seasons cited above I have seen a pair apparently rolling around each other close to the surface of the water. When diving deeply the whole of the tail fluke appears above the water. Individuals often swim with the whole head and rostrum exposed for a short distance. A juvenile was observed to leap with its whole body clear of the water (Pilleri, 1971A) and I have also seen an individual seemingly resting near the surface with the whole of its upper back and dorsal fin exposed for a period of three or four seconds.

Nothing has been recorded about their breeding but it is believed that the gestation period is eight to nine months (Walker et al., 1964) and that the young accompany their mothers for at least six months if not longer, suckling for four to five months.

#### Genus *TURSIOPS* Gervais, 1855

##### Key to the Genus *TURSIOPS*

Head and body length 1.75–3.6m. Snout short with upper jaw resembling neck of bottle in outline and well defined with 20–26 teeth in each side of both jaws. Belly markedly paler than back and sides

##### Key to the Species of *TURSIOPS* occurring in Pakistan Coastal Waters

Large size. Body 3m long. Back and sides dark greenish-grey. Belly paler greyish-white, 20–22 teeth on each side of both jaws. High falcate dorsal fin.

... *Tursiops aduncus*

##### *TURSIOPS ADUNCUS*

*Tursiops aduncus* Ehrenberg, 1833; Red Sea Bottle-nosed Dolphin or Eastern Bottle-nosed Dolphin (see Illustration 95).

**Description:** The Atlantic Bottle-nosed Dolphin (*Tursiops truncatus*) which is the common dolphin off the south eastern coast of the USA, was the first species to be extensively exhibited at aquaria and subjected to detailed behavioural studies. Since it figures commonly in photographs of performing dolphins its general appearance is familiar. *Tursiops aduncus* does not differ externally in any significant feature. The Eastern Bottle-nosed Dolphin is a graceful shaped and sleek animal with sharply pointed falcate dorsal fin which may measure about 400mm in height (see Fig. 81). The head and body length varies from 1.75–3.5m. A single female specimen captured near Sonmeani in November 1971 measured 2.4m in body length. The head is very characteristic with the angle of the mouth curling upwards in a permanent 'smile', and the beak or rostrum being rather short, broad and rounded, can be likened to the neck of an old-fashioned bottle. It is separated from the high domed forehead by a deep

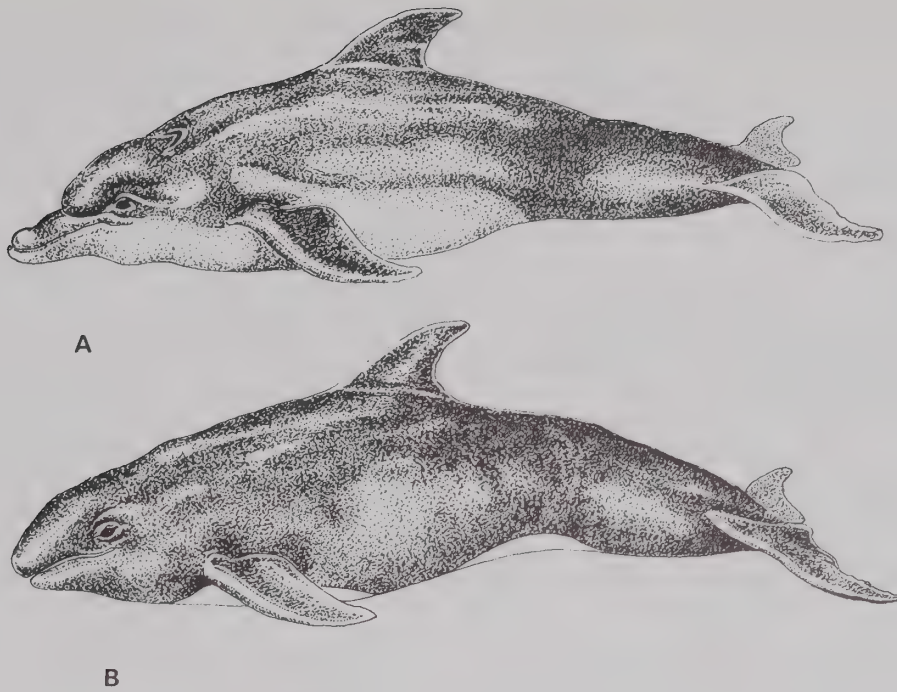


Illustration 95 A. *Tursiops aduncus*: Red Sea or Pacific Bottle-nosed Dolphin. (Based on photographs in *JBNHS* of specimen secured Laccadive Islands, and by Dr. G. Pilleri from near Sonmeani, Mekran coast.)  
 B. *Lagenorhynchus electra*: Indian Broad-beaked or Electra Dolphin. (Based on published photographs (Nishiwaki and Norris, 1965) of fresh killed specimen from Australian waters.)

groove. The teeth are conical and very sharp, and measure about 9mm wide at the base and number 20–22 on each side of both the upper and lower jaws.

This dolphin is dark grey to greenish-grey dorsally, and white below, with the dividing line between the flanks and belly being quite sharp. Sometimes the pectoral fins are a darker grey colour. There are no darker spots or blotches on the belly according to the specimen obtained near Sonmeani (Pilleri, in lit.). S. H. Prater refers to this species as having spots on the belly and he is possibly quoting Sterndale who may have confused this species with *S. lentiginosa* (Sterndale, 1884 and Prater, 1965). A photograph published from the Laccadive Islands supposedly of *Delphinus delphis*, appears to be the Eastern Bottle-nosed Dolphin (Dr. Burton, 1940).

**Distribution and Status:** *T. aduncus* extends throughout the Arabian Sea, Indian Ocean and probably the waters around Indonesia and Australia (Ellerman and Morrison-Scott, 1951).

It can be seen off the Mekran coast in huge herds, sometimes numbering several hundred individuals, but these sightings are mainly between December and March (Dr. Ranjha, late Director of the Zoological Survey of Pakistan, pers. comm.).

**Biology:** This is a gregarious species often associating in large schools. They are swift swimmers and often leap bodily out of the water and many populations of this dolphin are known to be seasonally migratory.

The Atlantic species *T. truncatus* has been well studied. It has a gestation period of 11–12 months with most births occurring from March to May. The young are comparatively slow growing and apparently dependent on their mothers for about 12 months, since they do not develop teeth with which to catch fish until they are about a year old. It is believed that they are not fully weaned until two years of age. The females are believed to attain sexual maturity at about six years of age (Gray, 1965).

The Atlantic population is known to ascend rivers and often to frequent bays and inshore waters. It was thought that *T. aduncus* inhabited deeper water and in this respect differed from *T. truncatus* (Slijper, 1962). The Bottle-nosed Dolphin of the Indian Ocean exhibits the same tendency to frequent shallow coastal waters and certainly feeds close inshore at times, according to the statements of Karachi fishermen as well as the evidence of the specimen captured at Sonmeani referred to above. It seems quite possible that during the summer monsoon months they migrate to deeper water a good distance from land.

**Genus LAGENORHYNCHUS** Gray, 1846

**Key to the Genus LAGENORHYNCHUS**

Medium size. Body length up to 2.5m. High falcate dorsal fin. Upper jaw curving down to a sharp-pointed snout without any constriction in front of forehead. Twenty-two to 45 needle-shaped teeth on each side of both jaws.



### Key to Species of LAGENORHYNCHUS occurring in Pakistan Coastal Waters

Twenty-two teeth on each side of lower jaw and 19 on each side of upper jaw. Body uniformly blackish-grey with prominent white lips and two white thoracic and abdominal patches.

... *Lagenorhynchus electra*

### LAGENORHYNCHUS ELECTRA

*Lagenorhynchus electra* Gray, 1846; Indian Broad-beaked Dolphin or Electra Dolphin.

Synonym *Peponocephala electra* Nishiwaki and Norris, 1965 (see Illustration 95).

**Taxonomy:** The Electra Dolphin was formerly assigned to the Genus *Lagenorhynchus* with four other species of broad-beaked dolphins. It has recently been put in a separate Genus *Peponocephala* due to its having a different shaped head and absence of a defined rostrum (Nishiwaki and Norris, 1965).

**Description:** In appearance this is a graceful streamlined dolphin with a prominent backward curving fin which may measure up to 0.5m in height. The pectoral flippers are rather slim and falcate shaped. There is no constriction in the nose or beak, the head being rather bluntly rounded and lacking any groove separating the rostrum from the forehead as in *Tursiops*. There are very scanty descriptions of its colouration

which seems to be variable but specimens appear to be uniformly blackish-grey all over with prominent white lips and light thoracic and abdominal patches (Dawbin et al., 1970). In *The Book of Indian Animals* it is incorrectly stated that the Electra Dolphin lacks these blotches on its underside (Prater, 1965). It appears to be a large dolphin, adults measuring up to 2.5m long. It has 22 teeth on each side of the upper jaw and 19 on each side of the lower jaw in adult specimens.

**Distribution and Status:** Apparently pelagic but occasionally sighted close in to shore as strandings have occurred in Australia (Dawbin, op. cit.).

According to the former Director of the Zoological Survey, this species is regularly seen off the Mekran coast but usually after the end of the monsoon and during the winter months when the Mekran coastal waters provide a particularly rich fishing ground (Dr. Ranjha, pers. comm.).

S. H. Prater (1965) also quotes this species as occurring off Indian coastal waters. No other evidence of its occurrence in Pakistan coastal waters has come to my notice. Extra-limitally it occurs in the south west Pacific from Australia to Hawaii, as well as the Indian Ocean (Ellerman and Morrison-Scott, 1951).

**Biology:** It is gregarious and occurs in large schools or herds numbering from 150–250 (Dawbin, op. cit.). It is a very swift swimmer. In the southern hemisphere it appears that the young are born during the spring (September) over a comparatively circumscribed breeding period.

## TECHNIQUES OF STUDYING MAMMALS IN PAKISTAN

For a detailed guide to wildlife investigational techniques the reader is advised to consult the specialist literature. Four comprehensive and valuable accounts are cited at the end of this Appendix. It is only intended here to indicate the sort of problems which the investigator has to contend with and the author's own experience in the context of local conditions in Pakistan.

Most amateur naturalists are deterred from studying mammals because, unlike birds, the majority are nocturnal in habits, seeking their food by smell. They are, in contrast to birds, shy and secretive and often able to detect the presence of man through scent being thus able to avoid visual contact. The Mammalogist therefore has to be content with building up knowledge from indirect observations such as foot tracks and can rarely make continuous visual observations of living wild specimens.

A few mammals are diurnal in activity and have provided wonderful opportunities for development in the relatively new discipline of ethology. There is much scope for original research contribution in such smaller diurnal mammals as Marmots, Jirds and Pikas. It is obviously much more difficult to study nocturnal species under natural conditions though valuable observations can often be made from captive specimens.

### Trapping

This is the most essential technique, especially in learning what smaller mammals occur in a locality. Some species are bold and curious and consequently readily enter traps. It is the shyer and more difficult species to trap which present particular challenges. Fossorial species, which do not need to appear above the ground surface to obtain their food, cannot be caught in most conventional types of traps. The easiest technique for above ground feeders is to lay an extensive trap line of back-breaking type of traps such as are sold to householders for killing mice. It is desirable to have two sizes, a larger rat trap model being necessary for rodents approximating to the size of that familiar mammal. Most large museums will be able to supply the address of a specialist company which manufactures traps of improved design whereby there is little likelihood of the skull being crushed which is an important provision for the zoological collector. Live trapping of small mammals can be most rewarding and the author has been able to get traps made by a local blacksmith according to the drawing in Fig. 85. Such traps have the disadvantage of being bulky to transport in large numbers but they are sturdy and highly successful if placed with due consideration for the terrain and presence of fresh tracks. The best bait in Pakistan is unleavened wheatcakes (chappatis) which can be obtained fresh in most localities at evening time when the traps are put out. This can be smeared with peanut-butter in order to enhance the scent carrying power of the bait. Chopped apple available in Pakistan for 8 months of the year is also an effective bait. Shrews can only be attracted by raw meat. In Pakistan the main problem in setting out traps arises from human interference. It is difficult to find any locality where one is away from human observance and local bystanders particularly children frequently remove such traps for use in their own homes. This can be a very expensive

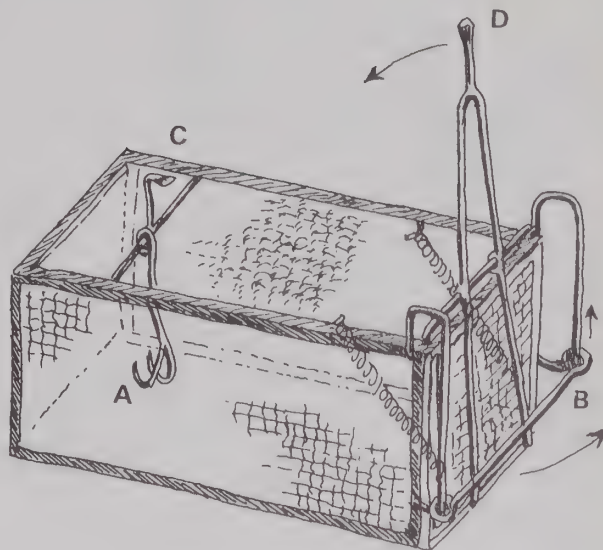


Fig. 85 Showing design of cage trap suitable for catching live rodents or shrews.

- A. Shows free hanging hook upon which bait is placed.
- B. Shows sliding bar which must be raised to open trap door before it is set. Trap is shown in closed position.
- C. Trap is set by sliding the tongue C attached to the bait hook over the tip of extension rod D which is welded onto trap door.

proposition when using metal cage traps. Carnivores sometimes drag traps away or paw them in trying to reach the bait. The only way to catch fossorial rodents is by the use of special gopher or mole traps and the American gopher trap shown in Fig. 86 is very effective and efficient but, of course, kills the animal. This trap can be pushed into the open tunnel-mouth after removing the loose top soil. It is best secured by a length of wire tied to a wooden peg as many rodents can otherwise drag this trap out of reach. If it is desired to capture live specimens of fossorial rodents it is usually necessary to have recourse to extensive excavation as well as the assistance of a second person armed with a net. It is also possible to catch fossorial rodents by placing a wire noose type of snare in the subterranean tunnel and I have used this method successfully with *Hyperacrius wyneii*.

Small carnivores and very large rodents can be live-trapped in the cage shown in Fig. 87. This can be made by a local blacksmith and I have successfully trapped wild cats, porcupines and mongooses in this design of trap.

Shooting can also be effective especially at night in the head-lights of a vehicle. A .22 rifle with special bullets loaded with dust shot should be used for most smaller rodents. Marmots (*Marmota caudata*) can be secured with ordinary .22 ammunition. With the help of a companion I have successfully captured nocturnal desert rodents by using a pressure (gas) lantern and a butterfly net.



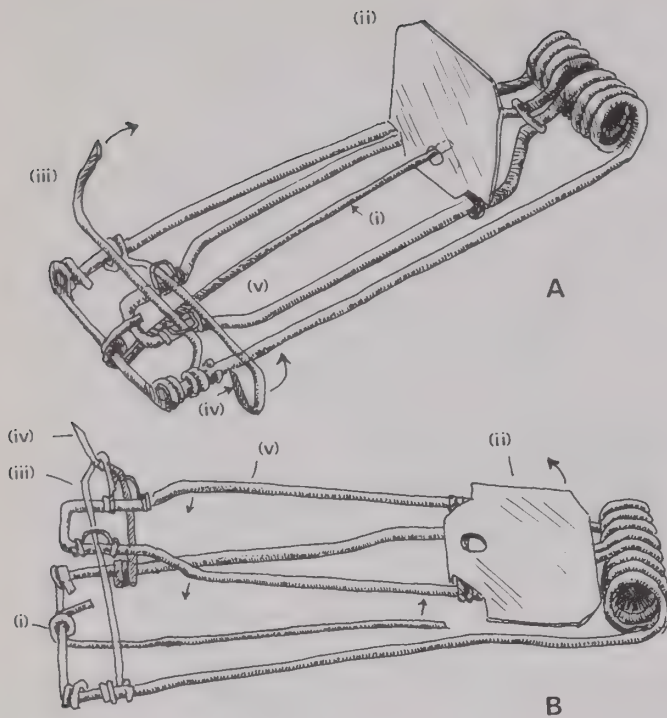


Fig. 86 Showing trap suitable for killing small burrowing or fossorial mammals. Known as a Gopher trap in the USA.

- A. Showing trap in set position. Trap is pushed into burrow mouth with the arms (iii) and (iv) towards the direction from which the animal is expected to approach. Depressing of hinged plate (ii), releases the rod (i) which forces up the spring thus englosing the arms (iii) and (iv).
- B. Showing same trap in sprung position. To set the trap the arm (v) must be pressed down against the torque of the spring and the plate is raised to engage the rod (i).

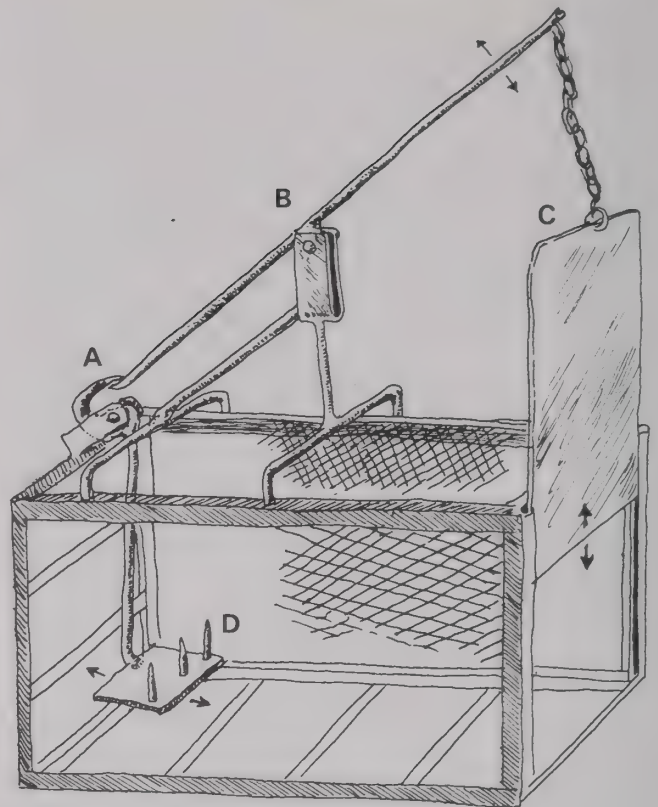


Fig. 87 Showing suitable cage trap for live trapping small carnivores, porcupines etc. Suggested dimensions — 2ft 6in. long by 1ft 6in. high. The trap-door, made from  $\frac{1}{8}$  gauge steel sheet, is heavy enough to slide down shut of its own accord if the bait hooks D are pulled forward to release the tongue A which holds down the fulcrum rod B. The cage should be made of heavy gauge expanded metal to withstand biting by stronger mammals.

### Recording

Field notes, in the sense of on the spot observations, can be of great value if made systematically. It is essential with every specimen captured or trapped to record the place, type of biotope and any other observations as to its apparent frequency of occurrence. With a dead specimen, four body measurements should always be recorded, as indicated in Fig. 88. The size and the general condition of the pelage, state of moult, colour of iris, and any other soft parts of the body should be carefully noted. If the collector has some ability, in this direction he should make drawings of the soles of the feet, perineal glands and external ear pinna. After many years of haphazard recording I have learned that a good system is to transpose everything into a small pocket note-book on the same evening on which the specimen was collected. Such note-books can become a permanent reference source.

Valuable biological information can be obtained by examining the reproductive tract and also stomach contents. External appearance of female specimens should be carefully noted with respect to the condition of the mammary glands if lactating. In males the length of the testes should be measured. Finally the specimen should be skinned and made up as a permanent museum study specimen.

This can be a laborious task and it takes practice to become proficient. A relatively small incision from the lower region of the belly down to the anus should be sufficient. Each hind leg is skinned out first and cut through around the ankle or carpal joints. Then the tail must be extracted after cutting through the cloaca or caecum. The only equipment necessary is a razor blade and a strong pair of sharp pointed scissors, together with some dry hardwood sawdust and cotton wool. Surgical scissors are easily available but for medium sized carnivores a small pair of bone cutting pliers are also desirable. Several thicknesses of wire are needed, relatively thick wire for inserting in the tail after this has been skinned out. Thinner wire can be pushed through the sole of each hind foot, up through the leg alongside the flank and into the fore-paw. The body is stuffed with cotton wool which can be moulded roughly into shape beforehand and bound with cotton thread. The sawdust helps to keep the pelage clean during skinning and to absorb fat and blood during skinning. An ordinary needle and cotton thread can be used to sew up the ventral incision and lips after the skin has been stuffed. The freshly removed skin should always be rubbed on the inside with insect repellent and preservative before inserting the cotton wool.

The best preservative is a mixture of three parts borax ( $\text{Na}_2\text{B}_4\text{O}_7$ ) and one part arsenous oxide ( $\text{As}_2\text{O}_3$ ). If arsenic is

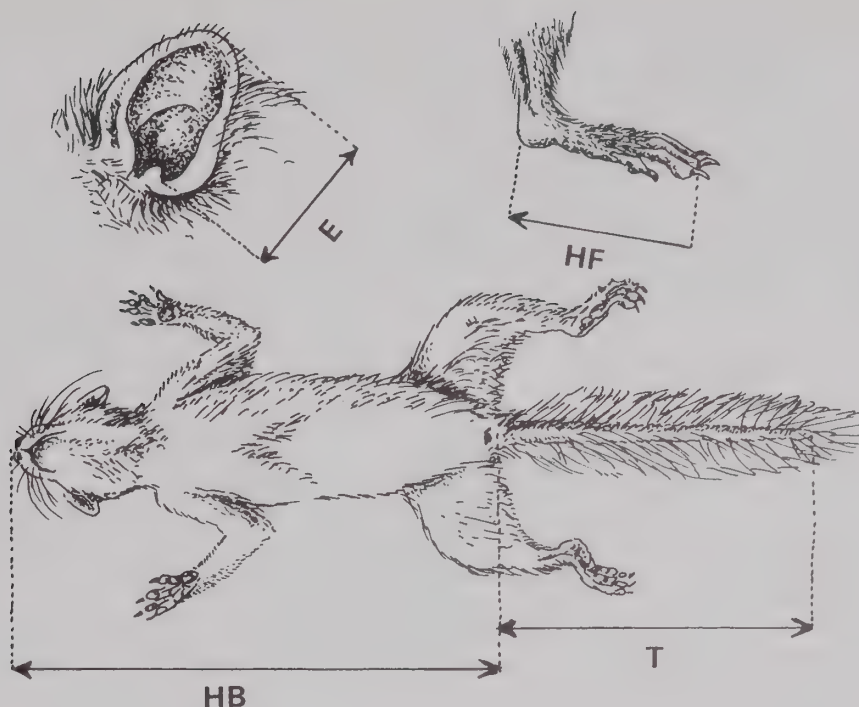


Fig. 88 Showing methods of taking standard body measurements of small mammals.

- HB. Length from tip of snout to root of tail measured straight and not following body contours of the animal.
- T. Tail excluding the terminal hairs at its tip.
- HF. Hind foot excluding claws with the digits straightened out and the heel bent.
- E. External ear pinna measured from bottom of notch in posterior margin of ear to the tip. Note some collectors prefer to record the total body length including the tail and then to give the tail measurement separately.

unavailable, borax alone will suffice, but much greater care must then be taken to clean the skin of any adhering fragments of flesh or fatty tissue. It should always be remembered that arsenic in any form is highly poisonous and the hands should be thoroughly washed after use. Rubber surgical gloves should be used if one's hands suffer from any small cuts or abrasions. After sewing up the skin, the skull is then carefully severed from the body taking care not to cut or crush the auditory bullae. The tongue and eyes can be removed with a pair of sharp pointed tweezers and the skull can be put in a box of sawdust to dry.

Finally, some attempt should be made to examine the stomach contents as well as the condition of the reproductive tract. In females each uterine horn should be examined and the number of foetuses counted as well as the number of placental scars, visible as round blackish spots. In males it is possible to tell if spermatogenesis is active if a smear from the epididymus can be examined microscopically. But it is often sufficient indication in smaller mammals that the tubules are visible to the naked eye when the epididymus is examined. After completing stuffing and sewing up study specimens should, if possible, be carefully pinned out in the best display position and covered with muslin cloth as a protection against blowflies until they are fully dried. The author has lost several valuable specimens after skinning through leaving them care-

lessly within the reach of stray dogs and cats, always a greater hazard when preparing specimens when out in the field or in camp.

Anyone who is going to do extensive collecting would be well advised to have two pairs of blunt forceps, and a number of pairs of surgical gloves. A surgical scalpel with changeable blades is also useful. The ultimate cleaning and preparing of skulls requires much patience and practice and most amateur collectors prefer to leave this task to museums where they donate their specimens. Skulls can however be boiled in plain water until the tissues are thoroughly softened and the muscles and sinew can then be scraped off the bone with a scalpel. Two or three minutes boiling is enough in the case of small rodent skulls. Skulls of small carnivores can be boiled in a dilute solution of caustic soda and require six to eight minutes of boiling. Some collectors bleach their skulls afterwards with hydrogen-peroxide. Every specimen should be carefully labelled with the collector's number and the skull should also bear the same number and it is of course axiomatic that no specimen is of any value unless the collector systematically makes out labels which are attached to the skin showing the date and place of capture, sex and the four basic measurements. Most rodents can be skinned fairly quickly and easily though I have found that at least two hours are required per specimen if adequate time is to be allowed for measure-



ment, sketching the soft parts and examining the reproductive tract afterwards. Some mammals are particularly difficult to skin if they possess special subcutaneous musculature to enable them to curl up their bodies. Thus, much more time and patience is required for skinning hedgehogs and the pangolin is notoriously difficult. Nearly all small mammals can be quickly and painlessly killed by exerting manual pressure in the thoracic region behind the armpits. In countries like Pakistan, chloroform is difficult if not impossible for the amateur to obtain. However ecto-parasites cannot be collected unless chloroform is used and the live mammal is first placed in a plastic bag.

### *Bats*

Besides the four conventional body measurements described above, it should be carefully noted from a freshly collected specimen as to whether there is a tragus or anti-tragus present and the length of the tragus should be measured: also the forearm length should be taken as shown in Fig. 11. This latter is a very helpful and constant measurement within each species whereas there can be very considerable variation in relative tail length. The tragus should be drawn and the place of attachment of the wing membrane to the hind foot as well as the shape and length of the calcar and lobe (see Fig. 12) carefully noted.

Capturing bat specimens is difficult since they will not enter traps. Many species can be collected from their diurnal roost by using a large butterfly net attached to a bamboo stick. Crevice roosting species can only be secured by waiting until they emerge to hunt at dusk. If their presence can be detected through the location of faeces beneath the crevice, their cries or their smell, then it is a relatively simple matter to stretch a Japanese mist net, as is used in bird ringing operations, across the cave entrance or over the eaves of a building within which the bats are known to be roosting. Some zoologists have been successful in shooting bats with dust shot as they leave their diurnal roost (D. L. Harrison, 1972) but this obviously requires considerable skill in marksmanship. Mist nets can also be attached between upright bamboo poles by the edge of water tanks, natural streams or the edge of groves of trees, wherever it is noted that bats frequently hunt. Nearly all insectivorous bats approach water to drink before they hunt extensively and in the semi arid regions of Pakistan, convenient watering places are not difficult to locate. It requires considerable patience to extract live bats after they are entangled in mist nets and it is advisable to visit such mist nets at intervals of one or two hours rather than to leave the net up throughout the night. Most bats can inflict painful bites and it is a wise precaution to wear an old pair of leather gloves for this task. For accurate skull, forearm and other body measurements professional zoologists use a Vernier calliper, but reasonably reliable measurements can be made with a flexible metal tape measure calibrated in millimetres.

### **Study of Captive Mammals**

Most professional zoologists during field expeditions cannot keep live caught animals for long periods and for serious ethological studies, the behaviour of species under captive conditions must be subject to cautious interpretation because of the many artificial environmental factors involved. However living in the same country where mammals were studied, and having a spacious garden, I have been able to make considerable use of opportunities for keeping wild caught specimens for prolonged periods of observation. In the case of ungulates I have bred wild goat, gazelle and sheep species in captivity

and have been able to make records of dental and horn growth in relation to age as well as rutting behaviour, alarm and fright reactions and so forth. Most small carnivores are frustrating to keep in captivity as they rarely display normal behaviour while under observation and remain savage and frightened. Furthermore it is only during the hours of darkness that they normally become active. I have found however that jackal and fox puppies are not difficult to rear. Rodents are particularly rewarding as most species breed readily in captivity and valuable data on breeding biology can thus be gained. It is necessary to build a series of special wooden cages which are completely lined with wire gauze and metal strips to protect the woodwork. Most rodents will give up any attempt to gnaw metal but can chew their way through a considerable thickness of wood in the space of one night's activity. Cages can be fitted with a sliding metal dividing door to facilitate cleaning and if the floor is also made of open wire gauze with a removable tray underneath, faeces can be conveniently removed each day. Each side of such wooden cages should be fitted with a small trap-door. Experience and practice enables one to develop improved techniques for keeping animals healthy and comfortable in captivity. Under confined conditions most rodents tend to be aggressive and males should be kept separate outside of the rut season. Very aggressive species such as the Migratory Hamster, Common Indian Gerbil or Lesser Bandicoot Rat will always fight unless kept singly. Some species are much more docile and social and flourish better in company. Psammophyllid species develop an excessively greasy or oily pelage if deprived of sand and Jerboas cannot be successfully kept on a bare wire gauze floor but do well on sand. Most small rodents are very susceptible to low temperatures and must be given adequate bedding and shelter in the form of a small cardboard box with a nest of chopped woodstraw and/or paper. It must be remembered that the equable temperatures and shelter provided by a subterranean burrow have to be simulated in captivity and most rodent species are unable to survive even in the relatively mild winters in the plains of Pakistan unless they can insulate their bodies during periods of sleep.

Insect eating bats are very difficult to keep successfully in captivity though the Megachiroptera will readily eat most forms of ripe fruit. Drinking water must be present for all the Microchiroptera to enable them to survive even a few hours in captivity. Artificially reared meal-worms, which are available from the pet trade in western countries, are not obtainable from Pakistan. In the summer and warmer months, it is possible to collect a good supply of insects by placing a lighted pressure (gas) lantern outside for a few hours after darkness, having covered the surrounding ground with a sheet of newspaper.

### **Field Observations**

Whenever possible the opportunity should be taken to become familiar with the appearance of the faecal pellets and foot tracks of mammals. It is not difficult with experience to differentiate between the faecal pellets of wild goat species and gazelles and between those of domestic sheep and goats. One can learn to detect the presence of rodents also from faecal remains particularly around certain embankments and rock crevices where natural signs of burrows are not so easy to detect (see Fig. 89). Since the ground surface in most parts of Pakistan is relatively bare of vegetation, foot-tracks are much easier to find than in more temperate regions of higher rainfall (see Fig. 90). The best tracks left by animals are the imprints made upon damp soil, sand or mud surfaces and

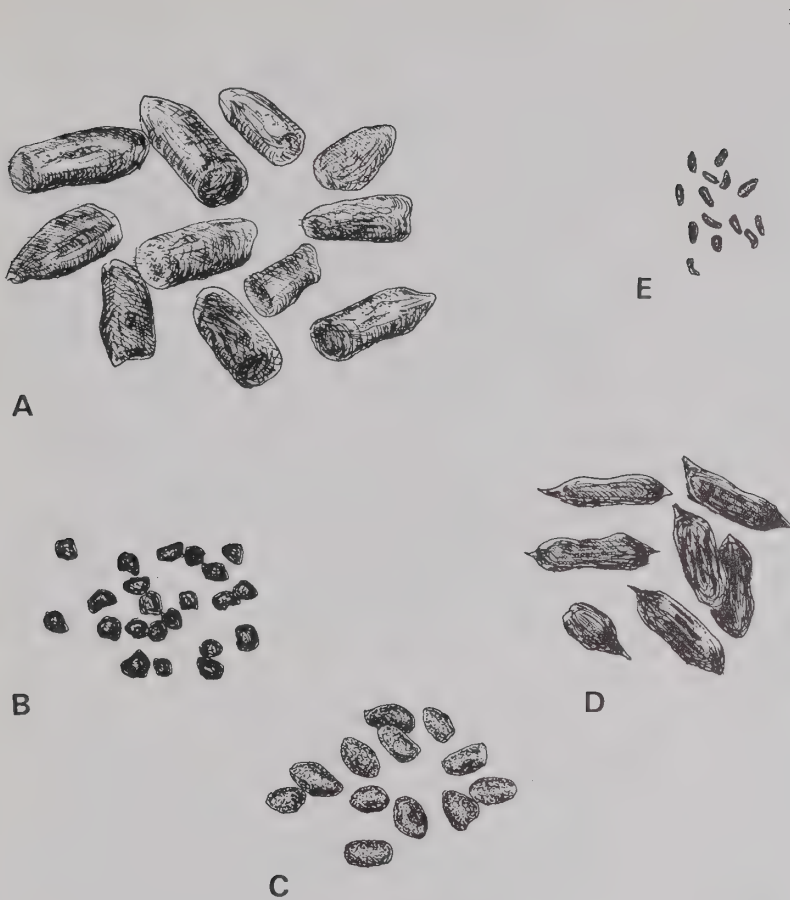


Fig. 89 Typical appearance of faecal pellets.  
A. *Boselaphus tragocamelus*.  
B. *Gazella gazella*.  
C. *Capra bircus*.  
D. *Hystrix indica*.  
E. *Meriones* species.  
Note that there is some variation in size and shape of pellets according to the diet. Drawings are approximate to same scale and about half actual size.

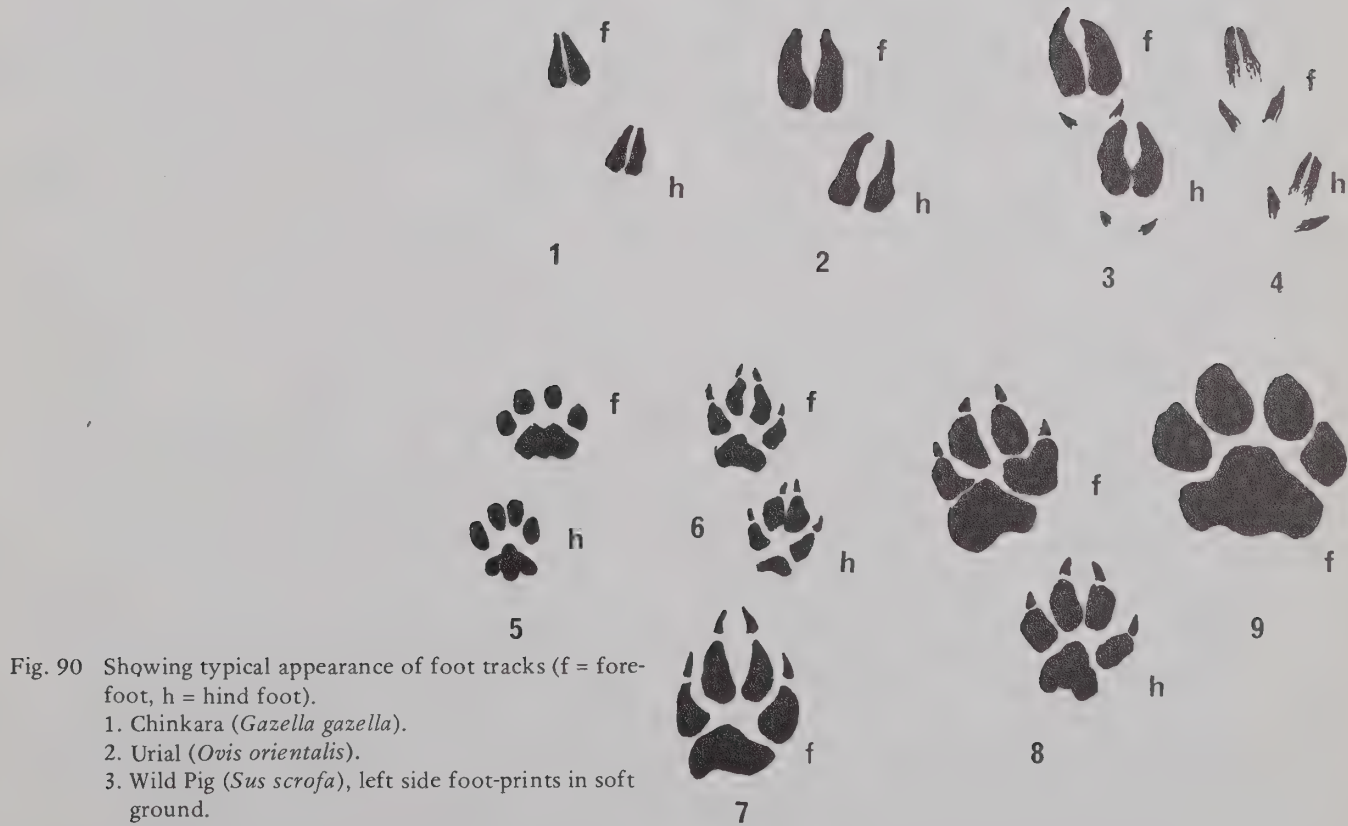


Fig. 90 Showing typical appearance of foot tracks (f = fore-foot, h = hind foot).  
1. Chinkara (*Gazella gazella*).  
2. Urial (*Ovis orientalis*).  
3. Wild Pig (*Sus scrofa*), left side foot-prints in soft ground.  
4. Musk Deer (*Moschus moschiferus*).  
5. Jungle Cat (*Felis cbaus*).  
6. Desert Fox (*Vulpes vulpes pusilla*), showing right side foot-prints.

7. Wolf (*Canis lupus*), right fore-foot.  
8. Striped Hyaena (*Hyaena hyaena*), right fore-foot.  
9. Leopard (*Panthera pardus*), left fore-foot.



tracks in both snow and dry sand though very conspicuous are often misleadingly distorted. In Pakistan roadside verges are often covered with a thick layer of fine powdered dust. Only in the early morning when there is a relatively higher humidity are such dust tracks useful as they rapidly become distorted or eroded later in the day. With the greater increase in road traffic a number of small mammals become crushed at night by passing vehicles and it is surprising how many valuable distributional records can be gathered from such traffic fatalities particularly when making journeys in the early morning. It is from such chance encounters that I have learned about the distribution of the Pangolin, the Small Indian Civet as well as the Hyaena in regions where they were hitherto not suspected.

Finally the amateur investigator should be cautioned against placing too much weight on secondhand accounts of wildlife observations, especially in a country such as Pakistan where the average local villager has very little genuine interest in observing the smaller mammals, but may, out of a natural and inherent sense of courtesy give the sort of answer or information which he thinks the interrogator wishes to hear. Perhaps it would seem unnecessary to labour this point, but undoubtedly much of value can be learned from questioning local people, yet I have on many occasions reached false conclusions and retained wrong ideas even for years as a result of placing too much reliance on secondhand reports.

#### Museums and Libraries

Besides trying to build up one's own personal library of books on wild mammals, it is extremely useful to take the opportunity whenever available to familiarize oneself with various species through studying museum collections and even zoo captive specimens. Only by increasing one's knowledge in this way can the student learn to make better use of his time in the field. At the present time the available material in the form of study specimens of mammals with the Zoological Survey of Pakistan and the Punjab University New Campus is

rather limited and there are no other mammalian collections in Pakistan. It is regrettable that the most comprehensive collections of Pakistan mammalia are with the Bombay Natural History Society's Museum in Bombay, the British Museum of Natural History and the Smithsonian National Museum in Washington.

It is not too far fetched an analogy to compare the student of mammalian natural history to the archaeologist. The latter must attempt to reconstruct a picture of past cultures and civilizations of the human race, often from the slenderest of clues — a few broken artifacts, perhaps the outline of the foundation of some building long since disintegrated. Similarly the study of mammals often has to be pieced together from little scraps of evidence. Sometimes an unexpected but precious encounter with a free wild specimen. More often a few tracks around a burrow and the dissection of faecal remains to build up evidence of territorial activity, food preferences, etc. Because we ourselves are mammals there is a special fascination in trying to unravel the secrets of the lives of this great class within the animal kingdom, and it is sincerely hoped that readers of this book will be tempted by their own interest to study mammals in some of the ways outlined above.

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## GAZETTEER OF PAKISTAN

In this appendix no attempt has been made to give the co-ordinates for every village and town located in Pakistan as this would be an onerous task beyond the needs of the specialized contents of this book. Instead an attempt has been made to give coordinates for every place mentioned in the text, including besides towns and villages; mountain peaks, known rest houses or inspection bungalows and occasionally streams, ravines, and lakes or reservoirs.

Whilst it has been possible to give the exact location for many places not shown on any published maps, it has not been possible for me to locate twelve places referred to in earlier publications or on the labels of older museum specimens, including Chitral (four places), Azad Kashmir (three places), Waziristan (two places), and Kalat State (three places).

There are several problems in compiling a Gazetteer of this kind. Firstly, relating to the problem of transliteration. Many places known only by their original Arabic, Persian or Sindhi names, have been given three or four different English spell-

ings in different published sources. Thus q and k are often interchangeable, as well as ai and e in older English spellings. I have not attempted to list all such alternative spellings but only those more frequently used.

Secondly, the same place name sometimes recurs in widely scattered localities. Usually only one such place is well known or actually mentioned in this book. There are several places called Ziarat in Pakistan, because this word denotes a shrine, but only one well-known locality is referred to in the book. Similarly there are at least two places called Basal, two rivers called Lora, two places called Jabba, and two called Duber which are mentioned in the text. In all these examples co-ordinates for both places are listed in the gazetteer.

For security reasons, maps of most regions of Pakistan have been unavailable for many years and this has made the compilation of a gazetteer particularly difficult. It has been necessary to rely largely upon old World War II aeronautical charts of the 1:1,000,000 scale which were only obtainable in Britain.

| Name               | Approximate Location   | Coordinates  |               |
|--------------------|--|--------------|---------------|
|                    |  | Latitude (N) | Longitude (E) |
| Abbotabad          | Hazara District  | 34° 08'      | 73° 12'       |
| Abdul Hakim        | Multan District  | 30° 33'      | 72° 07'       |
| Agram Pass         | Chitral, Afghan Border   | 36° 18'      | 71° 31'       |
| Ahmadpur East      | Bahawalpur Division  | 29° 08'      | 71° 14'       |
| Alipur             | Muzaffargarh   | 29° 23'      | 70° 54'       |
| Amandara           | Malakand Agency  | 34° 33'      | 71° 57'       |
| Amb                | Town, Amb State, west of Hazara District                       | 34° 18'      | 72° 51'       |
| Anam Bostan        | Nushki District, Afghan Border                                 | 29° 42'      | 65° 50'       |
| Ara                | Salt Range: not located on map                                 |              |               |
| Arandu             | South western Chitral  | 35° 19'      | 71° 34'       |
| Arifwala           | Sahiwal District   | 30° 17'      | 73° 04'       |
| Arkari Nullah      | North western Chitral  | 36° 05'      | 71° 47'       |
| Astola             | Island off Mekran coast  | 25° 17'      | 63° 50'       |
| Astor              | Gilgit Agency, south eastern district                          | 35° 22'      | 74° 52'       |
| Athara Hazari      | Jhang District   | 31° 11'      | 72° 07'       |
| Athmaqan           | Azad Kashmir   | 34° 15'      | 73° 40'       |
| Attock             | Campbellpur District   | 33° 54'      | 72° 14'       |
| Ayub National Park | Rawalpindi   | 33° 34'      | 73° 05'       |
|                    |  |              |               |
| Babusar            | Pass between Hazara District and Chilas                        | 35° 09'      | 74° 06'       |
| Babusar Village    | Village, Hazara District                                       | 35° 12'      | 74° 03'       |
| Badin              | Tharparkar District  | 24° 39'      | 68° 51'       |
| Bahaudin           | See Mandi Bahaiddin, Gujrat District                           | 32° 34'      | 73° 29'       |
| Bahawalnagar       | Town and headquarters northern district of Bahawalpur Division | 29° 59'      | 73° 16'       |
| Bahawalpur         | Town, Bahawalpur Division                                      | 29° 23'      | 71° 39'       |
| Bahrein            | Swat State   | 35° 20'      | 72° 32'       |
| Bajaur             | North Malakand Agency  | 34° 45'      | 71° 20'       |
| Bajwat             | Sialkot District: not located on map                           |              |               |
| Bakkar             | Mianwali District, Thal  | 31° 37'      | 71° 03'       |
| Balakot            | Hazara, Kaghan Valley  | 34° 33'      | 73° 19'       |
| Balgatar           | North Central Mekran   | 26° 10'      | 63° 45'       |
| Balloki            | Lahore District  | 31° 13'      | 73° 52'       |
| Baltit             | Hunza, Gilgit Agency   | 36° 19'      | 74° 41'       |
| Bannu              | Town, Bannu District, N.W.F.P.                                 | 33° 00'      | 70° 37'       |
| Baratpur           | Lahore District on Indian Border                               | 31° 41'      | 74° 28'       |
| Barian             | Murree Hills   | 33° 58'      | 73° 23'       |
| Baroghil           | See Brughal, N. Chitral  | 36° 51'      | 73° 22'       |
| Basal              | Hazara District, Kaghan Valley                                 | 35° 04'      | 73° 56'       |
| Basal              | Campbellpur District   | 33° 33'      | 72° 16'       |
| Batapur            | Near Lahore  | 31° 34'      | 74° 30'       |
| Batrasi Pass       | Hazara District, near Mansehra                                 | 34° 24'      | 73° 21'       |
| Battakundi         | Hazara District, Kaghan Valley                                 | 34° 56'      | 73° 46'       |
| Bela               | Town, west of Karachi  | 26° 13'      | 66° 19'       |
| Besti Nullah       | North western Chitral  | 36° 10'      | 71° 35'       |
| Bhakkar            | Muzaffargarh, Thal: see Bakkar                                 | 31° 37'      | 71° 03'       |

| Name                | Approximate Location                           | Coordinates  |               |
|---------------------|--|--------------|---------------|
|                     |  | Latitude (N) | Longitude (E) |
| Bharakao            | Murree foothills                               | 33° 44'      | 73° 09'       |
| Bhaun               | See Bhoun                                      |              |               |
| Bhogamarg           | Alternative spellings: Hazara District         | 34° 35'      | 73° 15'       |
| Bhogar Marg         |  |              |               |
| Bhog Marg           |  |              |               |
| Bhoun               | Salt Range                                     | 32° 52'      | 72° 46'       |
| Bhurban             | Murree Hills                                   | 33° 55'      | 73° 27'       |
| Bolan               | Pass, Sibi District                            | 29° 53'      | 67° 14'       |
| Brughal or Baroghal | Northern Chitral                               | 36° 51'      | 73° 22'       |
| Bubak               | Dadu District                                  | 26° 25'      | 67° 44'       |
| Buleji              | Near Karachi                                   | 24° 51'      | 66° 45'       |
| Burewala            | Sahiwal District                               | 30° 09'      | 72° 42'       |
| Burawai             | Kaghan Valley                                  | 34° 57'      | 73° 53'       |
| Burzil              | South east Astor or Azad Kashmir               | 34° 51'      | 75° 07'       |
| Campbellpur         | North west Punjab                              | 33° 47'      | 72° 22'       |
| Chacharan           | Western Bahawalpur Division on Indus           | 28° 52'      | 70° 27'       |
| Chachran            |  |              |               |
| Chachro             |  |              |               |
| Chagai              | Tharparkar District                            | 25° 06'      | 70° 16'       |
| Chakdarra           | Town, south west Baluchistan, Chagai District  | 29° 18'      | 64° 44'       |
| Chakdarra           | Malakand Agency                                | 34° 39'      | 72° 01'       |
| Chak Jabbi          | Kala Chitta Hills, Campbellpur                 | 33° 42'      | 72° 17'       |
| Chaklala            | Rawalpindi                                     | 33° 37'      | 73° 06'       |
| Chakri              | Salt Range                                     | 32° 47'      | 73° 28'       |
| Chak Shahana        | Multan District                                | 30° 12'      | 71° 59'       |
| Chakwal             | Salt Range                                     | 32° 56'      | 72° 52'       |
| Chaman              | Pishin District                                | 30° 55'      | 66° 25'       |
| Changa Manga        | Lahore District                                | 31° 05'      | 73° 59'       |
| Changla Gali        | Murree Hills                                   | 33° 59'      | 73° 23'       |
| Charsadda           | Peshawar District                              | 34° 09'      | 71° 49'       |
| Charwa              | Sialkot District: not located on map           |              |               |
| Chashma             | Dera Ismail Khan District                      | 32° 27'      | 71° 19'       |
| Chattar             | Murree foothills                               | 33° 47'      | 73° 09'       |
| Chauhar Jamali      | See Chuhar Jamali                              |              |               |
| Chautar             | Loralai District                               | 30° 19'      | 68° 03'       |
| Cherat (Hills)      | Southern Peshawar District                     | 33° 49'      | 71° 52'       |
| Chib                | South west Mekran                              | 26° 17'      | 63° 07'       |
| Chichawatni         | Sahiwal District                               | 30° 32'      | 72° 42'       |
| Chilas              | Southern Gilgit Agency                         | 35° 25'      | 74° 06'       |
| Chilianwala         | Gujrat District                                | 32° 39'      | 73° 37'       |
| Chiltan             | Near Quetta on northern Kalat border           | 30° 02'      | 66° 52'       |
| Chiniot             | Sarghoda District                              | 31° 43'      | 72° 59'       |
| Chistian            | Bahawalnagar District                          | 29° 48'      | 72° 52'       |
| Chitral             | Town, Chitral State                            | 35° 50'      | 71° 47'       |
| Choa Saida Shah     | Salt Range                                     | 32° 43'      | 72° 58'       |
| Chuhar Jamali       | Thatta District                                | 24° 24'      | 67° 59'       |
| Clifton             | Karachi  | 24° 48'      | 67° 02'       |
| Dadu                | Dadu District, north western Sind              | 26° 44'      | 67° 47'       |
| Dalbandin           | Chagai District                                | 28° 53'      | 64° 26'       |
| Daman Ghar Range    | Hills in West Central Baluchistan              | 30° 57'      | 67° 55'       |
| Dandikot            | Buner District in Swat                         | 34° 38'      | 72° 33'       |
| Daraban             | Dera Ismail Khan District                      | 31° 43'      | 70° 21'       |
| Darel Range         | Gilgit Agency, northern Chilas                 | 35° 46'      | 74° 06'       |
| Dargai              | Border of Mardan District and Malakand         | 34° 29'      | 71° 54'       |
| Darya Khan          | Mianwali District                              | 32° 27'      | 71° 29'       |
| Darzi Chach         | Nushki, Baluchistan                            | 29° 41'      | 65° 37'       |
| Daudkhel            | Salt Range, Mianwali District                  | 32° 52'      | 71° 34'       |
| Deg Nullah          | Shekhupura District                            | 31° 40'      | 74° 10'       |
| Dera Ghazi Khan     | Punjab, Trans-Indus District                   | 30° 03'      | 70° 38'       |
| Dera Ismail Khan    | N.W.F.P., southern part                        | 31° 48'      | 70° 54'       |
| Dera Nawab Sahib    | Bahawalpur Division (also known as Dera Nawab) | 29° 07'      | 71° 17'       |
| Derawar             | Cholisthan Desert (also known as Dharawar)     | 28° 46'      | 71° 20'       |
| Dhanial             | Forest, Hazara District                        | 34° 36'      | 73° 38'       |
| Digri               | Western Tharparkar District                    | 25° 09'      | 69° 07'       |
| Dina                | Jhelum District                                | 33° 02'      | 73° 37'       |
| Dipalpur            | Bahawalnagar District                          | 30° 40'      | 73° 39'       |
| Diplo               | Tharparkar District, near Rann of Kutch        | 24° 24'      | 69° 34'       |
| Dir                 | Town, Dir State, north of Malakand Agency      | 35° 12'      | 71° 52'       |
| Dodhlanwala Toba    | Cholisthan                                     | 29° 08'      | 72° 51'       |
| Dokri               | Larkana District                               | 27° 22'      | 68° 05'       |
| Dorah Pass          | Chitral, Afghan Border                         | 36° 07'      | 71° 14'       |
| Dok Dusra           | Northern Dir State                             | 35° 32'      | 72° 13'       |
| Domel               | Azad Kashmir                                   | 34° 21'      | 73° 28'       |
| Dormushkh Nullah    | Gilgit   | 35° 53'      | 74° 11'       |
| Drazinda            | Dera Ismail Khan District                      | 31° 42'      | 70° 08'       |
| Drosh               | South part of Chitral State                    | 35° 33'      | 71° 47'       |
| Duber               | Forest Reserve, Sukkur District                | 27° 32'      | 68° 23'       |



| Name                             | Approximate Location                       | Coordinates  |                         |
|----------------------------------|--|--------------|-------------------------|
|                                  |  | Latitude (N) | Longitude (E)           |
| Duber                            | Indus Kohistan                             | 35° 09'      | 72° 52'                 |
| Dullewala                        | Thal                                       | 31° 49'      | 71° 26'                 |
| Dundikot                         | Swat State                                 | 34° 17'      | 72° 30'                 |
| Dunyapur                         | Multan District                            | 29° 47'      | 71° 43'                 |
| Dura Pass                        | Chitral State                              | 36° 07'      | 71° 15'                 |
| Dunga Gali                       | Murree Hills                               | 34° 03'      | 73° 22'                 |
| Falakser                         | Peak, Swat Kohistan                        | 35° 42'      | 72° 48'                 |
| Fateh Jhang                      | Attock District, Salt Range                | 33° 34'      | 72° 39'                 |
| Fort Abbas                       | Cholistan, Bahawalnagar District           | 29° 12'      | 72° 52'                 |
| Fort Dharawar                    | See Derawar                                |              |                         |
| Fort Munroe                      | Dera Ghazi Khan District                   | 29° 54'      | 69° 59'                 |
| Fort Sandeman                    | Northern Baluchistan                       | 31° 21'      | 69° 28'                 |
| Gabral                           | Indus Kohistan                             | 35° 37'      | 72° 57'                 |
| Gabrial                          | Swat Kohistan                              | 35° 36'      | 72° 31'                 |
| Gambat                           | Khairpur State                             | 27° 19'      | 68° 32'                 |
| Gandhala                         | Salt Range: not located on map             | 32° 48'      | 73° 20'                 |
| Garhi Habibullah                 | Azad Kashmir                               | 34° 23'      | 73° 24'                 |
| Garm Chashma                     | Chitral                                    | 36° 02'      | 71° 44'                 |
| Ghadabar Garh                    | Hills in Loralai District                  | 30° 21'      | 69° 09'                 |
| Gharial                          | Murree Hills                               | 33° 55'      | 73° 27'                 |
| Gharibwal                        | Salt Range                                 | 32° 41'      | 73° 11'                 |
| Gharo                            | Thatta District                            | 24° 44'      | 67° 36'                 |
| Ghauspur                         | Jacobabad District                         | 28° 09'      | 69° 05'                 |
| Ghazi Ghat                       | Muzaffargarh District                      | 30° 06'      | 70° 53'                 |
| Ghora Dhaka                      | Murree Hills                               | 34° 02'      | 73° 26'                 |
| Ghotki                           | Sukkar District                            | 27° 59'      | 69° 19'                 |
| Ghulam Mohammed Barrage          | Hyderabad District                         | 25° 22'      | 68° 18'                 |
| Ghulam (Ullah)                   | Town, Thatta District                      | 24° 06'      | 67° 48'                 |
| Gilgit                           | Town, Gilgit Agency                        | 35° 54'      | 74° 18'                 |
| Gishk                            | Mountain range, northern Kalat             | 29° 12'      | 66° 52'                 |
| Gittidas or Gitidas              | Northern Hazara District                   | 35° 07'      | 73° 59'                 |
| Gizri                            | Near Karachi                               | 24° 46'      | 67° 06'                 |
| Gojra                            | Lyallpur District                          | 31° 09'      | 72° 42'                 |
| Gol Nullah                       | Chitral State (also called Chitral Gol)    | 35° 51'      | 71° 44'                 |
| Gora Dhaka                       | See Ghora Dhaka                            |              |                         |
| Gora Gali                        | Murree Hills                               | 33° 52'      | 73° 21'                 |
| Guddu Barrage                    | Sind-Bahawalpur Border                     | 28° 24'      | 69° 45'                 |
| Gujar Khan                       | Rawalpindi District                        | 33° 15'      | 73° 18'                 |
| Gujranwala                       | Gujranwala District, north west Punjab     | 32° 09'      | 74° 12'                 |
| Gujrat                           | Gujrat District, north west Punjab         | 32° 34'      | 74° 04'                 |
| Gulmerg                          | Rahimyar Khan District on Cholistan border | 28° 19'      | 70° 26'                 |
| Gupis                            | North western Gilgit                       | 36° 13'      | 73° 27'                 |
| Gurchani Hills                   | North west of Bugti Territory, Baluchistan | 29° 38'      | 69° 50'                 |
| Gwadur                           | Mekran Coast                               | 25° 07'      | 62° 20'                 |
| Gwaldai                          | Northern Dir (also known as Gwaldri)       | 35° 25'      | 72° 04'                 |
| Gwambuk Kaul                     | Central Mekran                             | 26° 09'      | 64° 15'                 |
| Hadeiro Lake }<br>Haidero Lake } | Thatta District                            | 24° 50'      | 67° 53'                 |
| Hafizabad                        | Gujranwala District                        | 32° 04'      | 73° 41'                 |
| Hala                             | Northern Hyderabad District                | 25° 48'      | 68° 25'                 |
| Haleji                           | Thatta District                            | 24° 49'      | 67° 44'                 |
| Hangu                            | Kohat District                             | 33° 32'      | 71° 04'                 |
| Hannah                           | Near Quetta                                | 30° 05'      | 67° 57'                 |
| Haramosh Range                   | Baltistan                                  | 35° 45'      | ext. 74° 50' to 75° 35' |
| Harappa                          | Sahiwal District                           | 30° 37'      | 72° 52'                 |
| Harboi                           | Kalat Division                             | 28° 55'      | 66° 42'                 |
| Haripur                          | Southern Hazara District                   | 33° 59'      | 72° 59'                 |
| Harnai                           | Sibi District                              | 30° 05'      | 67° 57'                 |
| Haroonabad                       | Bahawalpur District                        | 29° 36'      | 73° 08'                 |
| Hasan Abdul                      | Campbellpur District                       | 33° 48'      | 72° 42'                 |
| Hasilpur                         | Northern Bahawalpur District               | 29° 43'      | 72° 33'                 |
| Havelian                         | South east Hazara District                 | 34° 03'      | 73° 09'                 |
| Hazar Gunj                       | South eastern Kalat                        | 27° 30'      | 66° 11'                 |
| Hindu Bagh                       | North central Baluchistan                  | 30° 49'      | 67° 47'                 |
| Hinglaj                          | South east Mekran                          | 25° 45'      | 65° 35'                 |
| Hingol                           | River, eastern Mekran                      | 25° 45'      | 65° 33'                 |
| Hoshab                           | South central Mekran                       | 26° 01'      | 63° 55'                 |
| Hub River                        | Las Bela                                   | 25°          | 66° 50'                 |
| Hushe                            | Baltistan                                  | 35° 27'      | 76° 23'                 |
| Hyderabad                        | City, southern Sind                        | 25° 24'      | 68° 22'                 |
| Isa Khel                         | Bannu District, N.W.F.P.                   | 32° 41'      | 71° 17'                 |

| Name                   | Approximate Location                                       | Coordinates  |               |
|------------------------|--|--------------|---------------|
|                        |  | Latitude (N) | Longitude (E) |
| Ishkoman }             | Northern Gilgit  | 36° 32'      | 73° 49'       |
| Ishkuman }             |  |              |               |
| Islamabad              | Rawalpindi District  | 33° 43'      | 73° 05'       |
| Islam Headworks        | On Sutlej River, formerly Palla Headworks, Multan District | 29° 49'      | 72° 33'       |
| Jabba                  | Valley, Swat Kohistan                                      | 35° 17'      | 72° 43'       |
| Jabba                  | Mianwali District, Salt Range                              | 32° 48'      | 71° 42'       |
| Jacobabad              | Town, north west Sind                                      | 28° 17'      | 68° 26'       |
| Jajjian Abbas }        | Bahawalpur Division  | 28° 47'      | 70° 34'       |
| Jajja Abbasian }       |  |              |               |
| Jamal Dinwali          | Bahawalpur Division  | 28° 29'      | 70° 03'       |
| Jamroa Head            | Nawabshah District   | 26° 26'      | 68° 52'       |
| Jandola                | South Waziristan   | 32° 19'      | 70° 07'       |
| Jati or Jatti          | Southern Thatta District                                   | 24° 22'      | 68° 17'       |
| Jebri                  | Eastern Kalat  | 27° 30'      | 66° 38'       |
| Jhal Jhao              | Eastern Mekran or Hingol River                             | 26° 18'      | 65° 34'       |
| Jhang or Jhung }       | Jhang District   | 31° 16'      | 72° 19'       |
| Maghiana }             |  |              |               |
| Jhelum                 | Town, Jhelum District                                      | 32° 57'      | 73° 44'       |
| Jhuddo }               | Tharparkar District  | 24° 58'      | 69° 17'       |
| Jhudo }                |  |              |               |
| Jiwani                 | South west Mekran Coast                                    | 25° 02'      | 61° 45'       |
| Kabirwala              | Multan District  | 30° 24'      | 71° 52'       |
| Kaghan or Kagan        | Hazara District  | 34° 47'      | 73° 32'       |
| Kahuta                 | Murree foothills   | 33° 36'      | 73° 23'       |
| Kala Bagh              | On Indus, north of Mianwali                                | 34° 04'      | 71° 36'       |
| Kala Chitta            | Campbellpur District                                       | 33° 40'      | 72° 20'       |
| Kalam                  | Swat Kohistan  | 35° 31'      | 72° 35'       |
| Kalat                  | Town, northern Kalat Division                              | 29° 02'      | 66° 34'       |
| Kalian                 | Sialkot District: not located on map                       |              |               |
| Kaliphat }             | Peak in northern Sibi District                             | 30° 18'      | 67° 42'       |
| Khalifat }             |  |              |               |
| Kallar Kahar           | Salt Range   | 32° 47'      | 72° 43'       |
| Kaldi                  | Tharparkar   | 24° 30'      | 69° 17'       |
| Kalri Lake             | Thatta District  | 24° 56'      | 68° 03'       |
| Kalurkot               | Thal   | 32° 09'      | 71° 15'       |
| Kamalia                | Southern Lyallpur District                                 | 30° 43'      | 72° 43'       |
| Kand Forest Rest House | Hazara District  | 34° 09'      | 73° 56'       |
| Kandkhot               | Jacobabad District   | 28° 13'      | 69° 11'       |
| Kangar Kot             | Sind: not marked on map                                    | 24° 17'      | 69° 22'       |
| Kanori Hills           | Nowshera District  | 33° 54'      | 72° 01'       |
| Karchat                | Southern Dadu District                                     | 25° 46'      | 67° 44'       |
| Kanti                  | Southern Chitral   | 35° 35'      | 71° 41'       |
| Kargah Nullah          | Gilgit Agency  | 35° 56'      | 74° 13'       |
| Karrarkar              | Buner District, Swat                                       | 34° 26'      | 72° 13'       |
| Kashmor }              | Jacobabad District   | 28° 25'      | 69° 35'       |
| Kashmore }             |  |              |               |
| Kasur                  | Lahore District  | 31° 08'      | 74° 27'       |
| Kaurang }              | Indus Kohistan   | 35° 30'      | 73° 01'       |
| Karang }               |  |              |               |
| Kaur Bridge            | N.W.F.P.: not located on map                               |              |               |
| Kawai                  | Lower Kaghan Valley, Hazara                                | 34° 38'      | 73° 26'       |
| Kelat                  | See Kalat Town   |              |               |
| Keti Bandar            | Indus mouth  | 24° 08'      | 67° 27'       |
| Keti Shahu             | Indus River, Sukkur District                               | 27° 54'      | 68° 55'       |
| Khabbaki               | Salt Range   | 32° 37'      | 72° 14'       |
| Khadeji Falls          | Karachi District   | 25° 06'      | 67° 32'       |
| Khair-i-Murat          | Hills in Salt Range  | 33° 27'      | 72° 47'       |
| Khairpur               | Town, northern Sind  | 27° 08'      | 68° 47'       |
| Khairpur Nathan Shah   | Khairpur District  | 27° 06'      | 68° 44'       |
| Khalifat               | See above: Kaliphat, northern Sibi District                | 30° 18'      | 67° 42'       |
| Khanewal               | Multan District  | 30° 18'      | 71° 56'       |
| Khanori Hills          | Malakand Agency  | 34° 27'      | 72° 14'       |
| Khanpur                | Bahawalpur Division  | 28° 38'      | 70° 38'       |
| Khanspur               | Murree Hills   | 34° 02'      | 73° 24'       |
| Kharan                 | South east Kalat   | 28° 34'      | 65° 26'       |
| Kharian                | Jhelum District  | 32° 49'      | 73° 53'       |
| Karochi Dak            | South west Mekran  | 25° 51'      | 63° 46'       |
| Kharrar Jheel          | Sahiwal District   | 30° 52'      | 73° 31'       |
| Khaur                  | Attock District  | 33° 14'      | 72° 27'       |
| Kheti Bandar           | See above: Keti Bandar, Indus mouth                        | 24° 08'      | 67° 27'       |
| Khewra                 | Salt Range   | 32° 38'      | 73° 01'       |
| Khirgi or Kirgi        | South Waziristan   | 32° 18'      | 70° 11'       |
| Khirsar                | Forest Reserve, Indus River, Southern Sind                 | 24° 36'      | 68° 02'       |
| Khojak Pass            | Pishin District  | 30° 52'      | 66° 28'       |
| Khudo }                | North east Las Bela  | 26° 50'      | 66° 55'       |
| Khude }                |  |              |               |



| Name                 | Approximate Location   | Coordinates  |               |
|----------------------|--|--------------|---------------|
|                      |  | Latitude (N) | Longitude (E) |
| Khujoorag Hills      | Southern Swat, Buner   | 34° 37'      | 72° 20'       |
| Khunjerab Pass       | Northern Border of Hunza   | 36° 52'      | 75° 27'       |
| Khushab              | Sarghoda District  | 32° 17'      | 72° 21'       |
| Khuzdar              | South east Kalat Division  | 27° 53'      | 66° 36'       |
| Khyber Agency        | North west of Peshawar   | 34° 05'      | 71° 05'       |
| Killick Pass         | North west boundary of Hunza, the most northerly point in Pakistan | 37° 04'      | 74° 42'       |
| Kingri               | Eastern Lorelai District   | 30° 26'      | 69° 48'       |
| Kirani               | Chiltan Hills, Quetta  | 30° 11'      | 66° 57'       |
| Kohat                | Town, Kohat District   | 33° 34'      | 71° 26'       |
| Koh-i-Maran Range    | North east Kalat   | 29° 26'      | 66° 52'       |
| Koh-i-Safed Range    | Upper Kurram Valley  | 34°          | 70°           |
| Kolwa                | Baluchistan  | 26° 12'      | 64° 39'       |
| Kolwakkupp Hills     | Northern Mekran  | 26° 10'      | 64° 50'       |
| Kot Addu             | Muzaffargarh District  | 30° 28'      | 70° 59'       |
| Kot Diji             | Khairpur District  | 27° 21'      | 68° 42'       |
| Kotri                | Hyderabad District   | 25° 21'      | 68° 19'       |
| Kulachi              | Dera Ismail Khan District  | 31° 55'      | 70° 28'       |
| Kuldan               | South east Mekran  | 26° 09'      | 64° 15'       |
| Kullanch             | Southern Mekran  | 25° 35'      | 63° 12'       |
| Kululai              | Rest House in southern Swat Kohistan                               | 35° 18'      | 72° 35'       |
| Kundian              | Mianwali District  | 32° 27'      | 71° 29'       |
| Kushakgarh           | Eastern Kohat District   | 33° 29'      | 71° 53'       |
| Kutabpur             | See Qutabpur   |              |               |
| Ladam Sar            | Bahawalpur District  | 29° 22'      | 71° 59'       |
| Ladiun               | Thatta District  | 24° 18'      | 68° 03'       |
| Lahore               | North east Punjab  | 31° 33'      | 74° 19'       |
| Lak Bidok            | Las Bela   | 25° 12'      | 66° 45'       |
| Lakhat               | Forest, Nawabshah District   | 26° 36'      | 67° 53'       |
| Lakhi                | Dadu District, Sind Kohistan                                       | 26° 16'      | 67° 53'       |
| Lalamusa             | Gujrat District  | 32° 42'      | 73° 57'       |
| Lalazar              | Hazara District, Kaghan Valley                                     | 34° 54'      | 73° 46'       |
| Lal Suhanran         | Bahawalpur District  | 29° 21'      | 72° 01'       |
| Laluser              | See Lulusar  |              |               |
| Landi Kotal          | Khyber Agency  | 34° 07'      | 71° 20'       |
| Landi }              | North of Karachi   | 24° 52'      | 67° 13'       |
| Landhi }             |  |              |               |
| Larkana              | Town, north western Sind   | 27° 32'      | 68° 12'       |
| Laspur Nullah        | Chitral  | 36° 12'      | 72° 28'       |
| Lehtrar              | Murree foothills   | 33° 42'      | 73° 26'       |
| Leiah                | Muzaffargarh District, Thal  | 30° 57'      | 70° 57'       |
| Lodhran              | Multan District  | 29° 32'      | 71° 37'       |
| Lora                 | Nullahor River, Chagai   | 29° 30'      | 65° 15'       |
| Lora                 | River, Pishin District   | 30° 22'      | 66° 53'       |
| Loralai }            | Town, Loralai District, north east Baluchistan                     | 30° 43'      | 68° 38'       |
| Lorelai }            |  |              |               |
| Lowarai Pass         | Northern Dir/Chitral Border  | 35° 22'      | 71° 47'       |
| Luddan               | Multan District  | 29° 54'      | 72° 34'       |
| Ludak Sar            | Swat Kohistan  | 35° 41'      | 72° 46'       |
| Lulusar              | Lake, northern Hazara District                                     | 35° 05'      | 73° 56'       |
| Lutko Nullah         | Northern Chitral   | 36° 05'      | 71° 20'       |
| Lyallpur             | City, Lyallpur District  | 31° 25'      | 73° 07'       |
| Mach                 | Northern Kalat Division  | 29° 52'      | 67° 20'       |
| Madyan               | Swat   | 35° 08'      | 72° 32'       |
| Maggowal             | Gujrat District  | 32° 29'      | 73° 54'       |
| Mahendri             | Swat: not located on the map                                       |              |               |
| Mailsi               | Multan Division  | 29° 42'      | 72° 12'       |
| Makli Hills          | Thatta District  | 24° 46'      | 67° 57'       |
| Malach               | Murree Hills   | 34° 03'      | 73° 21'       |
| Malakand             | Pass, Malakand Agency  | 34° 34'      | 71° 57'       |
| Malika Parbat Peak   | Hazara District  | 34° 48'      | 73° 43'       |
| Malir                | Karachi  | 24° 59'      | 67° 13'       |
| Malkal               | Azad Kashmir: not located on map                                   |              |               |
| Manchar              | Dadu District  | 26° 24'      | 67° 38'       |
| Mangla               | Jhelum District  | 33° 08'      | 73° 40'       |
| Mankial Peak         | Swat Kohistan  | 35° 19'      | 72° 44'       |
| Manshera             | Hazara District  | 34° 19'      | 73° 12'       |
| Marala               | Sialkot District on Chenab River                                   | 32° 40'      | 74° 29'       |
| Mardan               | Town, Mardan District  | 34° 19'      | 71° 56'       |
| Margalla Hills }     | Murree Foothills   | 33° 48'      | 73° 10'       |
| Marghala Hills }     |  |              |               |
| Marri Mungkhar Hills | North of Karachi   | 25° 07'      | 67° 06'       |
| Massan Valley        | Mianwali District, Salt Range                                      | 32° 52'      | 71° 43'       |
| Mastuj               | Northern Chitral   | 36° 17'      | 72° 31'       |
| Mastung              | Northern Kalat   | 29° 48'      | 66° 52'       |
| Matiltan             | Swat Kohistan  | 35° 34'      | 72° 10'       |

| Name            | Approximate Location                  | Coordinates     |               |
|-----------------|---------------------------------------|-----------------|---------------|
|                 |                                       | Latitude (N)    | Longitude (E) |
| McLeod Ganj     | Bahawalnagar District                 | 30° 09'         | 73° 44'       |
| Metla           | Bahawalpur District                   | 28° 51'         | 70° 54'       |
| Mian Channun    | Multan District                       | 30° 27'         | 72° 22'       |
| Miandam         | Swat                                  | 35° 04'         | 72° 34'       |
| Mianwali        | Town, Mianwali District               | 32° 13'         | 71° 33'       |
| Mingora         | Swat                                  | 34° 47'         | 72° 22'       |
| Miran Shah      | North Waziristan                      | 33° 01'         | 70° 04'       |
| Miran Jani      | Peak, Murree Hills                    | 34° 06'         | 73° 25'       |
| Mirpur          | Jacobabad District                    | 28° 12'         | 68° 48'       |
| Mirpurkhas      | Town, Tharparkar District             | 25° 32'         | 69° 01'       |
| Mirpursakro     | Thatta District                       | 24° 32'         | 67° 38'       |
| Mithankot       | Dera Gazi Khan District               | 28° 57'         | 70° 22'       |
| Moen Jodaro     | Larkana District (see Mohen Jodero)   | 27° 18'         | 68° 08'       |
| Mogi Wala Toba  | Bahawalnagar District, Cholistan      | 28° 50'         | 73° 02'       |
| Mogli           | Salt Range: not located on the map    |                 |               |
| Mohen Jodero    | Larkana District                      | 27° 18'         | 68° 08'       |
| Mohib Shah      | Muzaffargarh District                 | 29° 37'         | 70° 44'       |
| Momin           | Peak, south Waziristan, not located   |                 |               |
| Mughalpure      | Lahore                                | 31° 33'         | 74° 20'       |
| Mukshpuri       | Peak, Murree Hills                    | 34° 04'         | 73° 26'       |
| Multan          | City, Multan District                 | 30° 11'         | 71° 26'       |
| Munian Wala     | Bahawalnagar, Cholistan               | 30° 10'         | 73° 43'       |
| Murdar          | Quetta, Pishin District               | 30° 13'         | 67° 07'       |
| Murghazar       | Swat                                  | 34° 39'         | 72° 19'       |
| Muridke         | Shekhupura District                   | 31° 47'         | 74° 15'       |
| Murree          | Town, Murree Hills                    | 33° 54'         | 73° 22'       |
| Musa-ke-Masala  | Peak, Hazara District                 | 34° 52'         | 73° 31'       |
| Muzaffar Garh   | Town, Muzaffargarh District           | 30° 04'         | 71° 12'       |
| Muzaffarabad    | Town, Azad Kashmir                    | 34° 22'         | 73° 28'       |
| Nagar }         | Gilgit Agency                         | 36° 16'         | 74° 44'       |
| Nagir }         |                                       |                 |               |
| Nagar Parkar    | South east Tharparkar                 | 24° 20'         | 70° 46'       |
| Naltar          | Gilgit                                | 36° 07'         | 74° 14'       |
| Nammal          | Lake, Salt Range                      | 32° 40'         | 71° 49'       |
| Nanga Parbat    | Gilgit, Astor District                | 35° 13'         | 74° 35'       |
| Nankana Sahib   | Lahore District                       | 31° 27'         | 73° 43'       |
| Naran           | Hazara District                       | 34° 53'         | 73° 39'       |
| Narowal         | Sialkot District                      | 32° 07'         | 74° 52'       |
| Nathan Shah     | Dadu District                         | 27° 06'         | 67° 43'       |
| Nathia Gali     | Murree Hills                          | 34° 04'         | 73° 24'       |
| Naukot          | Tharparkar District                   | 24° 52'         | 69° 27'       |
| Naundero }      | Larkana District                      | 27° 40'         | 68° 21'       |
| Naudero }       |                                       |                 |               |
| Nawabshah       | Town, Nawabshah District              | 26° 15'         | 68° 24'       |
| Nawan           | Azad Kashmir, Jhelum Valley           | 33° 32'         | 73° 40'       |
| Noa Kundi }     | Western Chagai                        | 28° 49'         | 62° 46'       |
| Noa Khandi }    |                                       |                 |               |
| Nowshera        | Peshawar District                     | 34°             | 71° 59'       |
| Nurpur          | Salt Range                            | 32° 39'         | 72° 31'       |
| Nurpur Shahan   | Margalla Hills, Rawalpindi District   | 33° 44'         | 73° 07'       |
| Nushki          | Chagai or Nushki District             | 29° 33'         | 66° 02'       |
| Okara           | Sahiwal District                      | 30° 48'         | 73° 27'       |
| Ormara          | Mekran Coast                          | 25° 13'         | 64° 40'       |
| Pab             | Eastern Las Bela                      | From 26° to 27° | 66° 35'       |
| Pail            | Salt Range                            |                 | 72° 28'       |
| Panjgur         | Northern Mekran                       | 26° 56'         | 64° 06'       |
| Panjnad         | On Muzaffargarh and Bahawalpur border | 29° 21'         | 71° 02'       |
| Parachinar      | Upper Kurram Agency                   | 33° 53'         | 70° 07'       |
| Paras           | Hazara District                       | 34° 39'         | 73° 31'       |
| Parkuta         | Baltistan                             | 35° 07'         | 75° 57'       |
| Parom           | See Prom                              |                 |               |
| Pasni           | Mekran Coast                          | 25° 15'         | 63° 28'       |
| Pasrur          | Sialkot District                      | 32° 15'         | 74° 40'       |
| Pasu            | Hunza                                 | 36° 28'         | 74° 53'       |
| Pattoki         | Lahore District                       | 30° 20'         | 73° 22'       |
| Peiwar          | Upper Kurram Agency                   | 33° 56'         | 69° 56'       |
| Peshawar        | City, Peshawar District               | 34° 01'         | 71° 33'       |
| Petaro          | See Pithoro                           |                 |               |
| Phandar         | North west Gilgit                     | 36° 10'         | 73° 13'       |
| Philgar         | Mountain Ridge, central Baluchistan   | 30° 26'         | 67° 26'       |
| Phulra          | Cholistan                             | 29° 10'         | 72° 50'       |
| Pind Dadan Khan | Salt Range, Jhelum District           | 32° 36'         | 72° 57'       |
| Pindi Gheb      | Attock District                       | 33° 13'         | 72° 16'       |
| Piplan          | Northern Thal, Mianwali District      | 32° 17'         | 71° 22'       |



| Name            | Approximate Location                       | Coordinates  |               |
|-----------------|--|--------------|---------------|
|                 |  | Latitude (N) | Longitude (E) |
| Pirawala }      | Multan District, Forest Plantation         | 30° 21'      | 72° 02'       |
| Pirowala }      |  |              |               |
| Pir Ghal        | Waziristan                                 | 32° 47'      | 69° 46'       |
| Pishin          | Town, Pishin District                      | 30° 39'      | 67°           |
| Pithoro         | Dadu District                              | 25° 32'      | 68° 21'       |
| Potwar          | Plateau in northern Punjab                 | 33° 38'      | 73°           |
| Prom            | North Central Mekran                       | 26° 38'      | 64° 21'       |
| Qaidabad        | Mianwali District, Thal                    | 32° 18'      | 71° 54'       |
| Quetta          | Central Baluchistan                        | 28° 14'      | 66° 56'       |
| Qutabpur        | Multan District                            | 29° 54'      | 71° 47'       |
| Raghai River    | Kharan District, Baluchistan               | 27° 20'      | 65° 20'       |
| Rahimyar Khan   | Town, Rahimyar Khan District               | 28° 24'      | 70° 18'       |
| Rahwali         | Gujranwala District                        | 32° 14'      | 74° 20'       |
| Rajanpur        | Town, Dera Ghazi Khan District             | 29° 06'      | 70° 17'       |
| Rajari Forest   | Hyderabad District                         | 25° 37'      | 68° 23'       |
| Raiwind         | Lahore District                            | 31° 15'      | 74° 12'       |
| Rakaposhi       | Peak, Gilgit                               | 36° 09'      | 74° 30'       |
| Rakhshani       | Plateau, south western Kalat               | 27° 05'      | 64° 50'       |
| Rama            | Lake, Astor, Gilgit Agency                 | 35° 18'      | 74° 46'       |
| Rasul           | Gujrat District                            | 32° 42'      | 73° 33'       |
| Ratto }         | Astor, Gilgit                              | 35° 19'      | 74° 49'       |
| Rattoo }        |  |              |               |
| Rawal           | Lake, Rawalpindi District                  | 33° 40'      | 73° 96'       |
| Rawalpindi      | City, northern Punjab                      | 33° 36'      | 73° 03'       |
| Razmak          | South Waziristan                           | 32° 42'      | 69° 52'       |
| Renala Khurd    | Sahiwal District                           | 30° 53'      | 73° 34'       |
| Rohri           | Sukkur District                            | 27° 41'      | 68° 54'       |
| Rohtas          | Jhelum District, Salt Range                | 32° 58'      | 73° 36'       |
| Rondu           | Baltistan                                  | 35° 36'      | 75° 09'       |
| Rondu           | Chitral, see Aradnu                        |              |               |
| Rupal           | Astor, Gilgit Agency                       | 35° 11'      | 74° 43'       |
| Sadikabad       | Town, southern part of Bahawalpur          | 28° 18'      | 70° 02'       |
| Safed Koh Range | Upper Kurram Agency                        | 34°          | 70°           |
| Sagian          | Azad Kashmir: not located on map           |              |               |
| Sahiwal         | Formerly Montgomery Town, Sahiwal District | 30° 39'      | 73° 06'       |
| Saidpur         | Margalla Hills                             | 33° 44'      | 73° 07'       |
| Saidu Sharif    | Swat                                       | 34° 44'      | 72° 21'       |
| Saiful Maluk    | Lake, Upper Hazara District                | 34° 52'      | 73° 41'       |
| Sai Nullah      | Gilgit Agency, Chilas                      | 35° 45'      | 74° 20'       |
| Sakesar         | Salt Range, Mianwali District              | 32° 33'      | 71° 57'       |
| Sakhi Sarwar    | Dera Ghazi Khan District                   | 29° 58'      | 70° 17'       |
| Sakra           | Mardan and Swat Boundary                   | 34° 27'      | 72° 17'       |
| Samundri        | Lyallpur District                          | 31° 04'      | 72° 58'       |
| Sandeman Tangi  | North east Baluchistan                     | 30° 23'      | 67° 41'       |
| Sanghar         | Hyderabad District                         | 26° 03'      | 68° 57'       |
| Sangriaro       | Lake, Sanghar District                     | 26° 03'      | 69° 12'       |
| Sarghoda        | Town, Sarghoda District                    | 32° 04'      | 72° 41'       |
| Sari            | Hazara District                            | 34° 34'      | 73° 32'       |
| Sarkhand }      | Nawabshah District                         | 26° 08'      | 68° 16'       |
| Sakrand }       |  |              |               |
| Sehwan          | Dadu District                              | 26° 26'      | 67° 51'       |
| Shah Bandar     | Indus Mouth                                | 24° 08'      | 67° 53'       |
| Shahdadpur      | Hyderabad District                         | 25° 56'      | 68° 38'       |
| Shahdara        | Lahore                                     | 31° 37'      | 74° 18'       |
| Shahid Pani     | Hazara District                            | 34° 36'      | 73° 21'       |
| Shah Nurani     | Peak, Pab Hills, Las Bela                  | 27° 30'      | 66° 35'       |
| Shahpur         | Nawabshah District, Sind                   | 26° 35'      | 67° 58'       |
| Shaikh Badin }  | Peak, Dera Ismail Khan District            | 32° 18'      | 70° 48'       |
| Shaikh Budin }  |  |              |               |
| Shalozan        | Upper Kurram Valley                        | 33° 57'      | 70° 01'       |
| Sham            | Bugti Territory, south eastern Baluchistan | 29° 20'      | 69° 40'       |
| Shandur         | North western Gilgit                       | 34° 43'      | 73° 24'       |
| Shangla         | Swat                                       | 34° 54'      | 72° 36'       |
| Shankar Garh    | Astor, Gilgit Agency                       | 35° 02'      | 74° 56'       |
| Sharan          | Hazara District                            | 34° 43'      | 73° 20'       |
| Sharig          | Sibi District                              | 30° 11'      | 67° 41'       |
| Shastun         | Iranian Baluchistan                        | 27° 22'      | 62° 20'       |
| Sheikhupura }   | Lahore District                            | 31° 43'      | 73° 59'       |
| Shekhupura }    |  |              |               |
| Shenkar Garh    | See Shankar Garh                           |              |               |
| Shigar          | Baltistan                                  | 35° 25'      | 75° 44'       |
| Shikarpur       | Jacobabad District                         | 27° 57'      | 68° 38'       |
| Shimshal        | Hunza, Gilgit Agency                       | 36° 27'      | 75° 18'       |
| Shingar         | Hills in Zhob District                     | 31° 30'      | 69° 05'       |

| Name                  | Approximate Location                               | Coordinates  |               |
|-----------------------|--|--------------|---------------|
|                       |  | Latitude (N) | Longitude (E) |
| Shinghai Gah Nullah   | Gilgit   | 35° 51'      | 74° 17'       |
| Shishpar Nullah       | Hunza, Gilgit Agency                               | 36° 50'      | 74° 55'       |
| Shogran               | Hazara District                                    | 34° 37'      | 73° 28'       |
| Shojh                 | Hazara District                                    | 34° 33'      | 73° 39'       |
| Shorab                | Central Kalat, see Sorab                           |              |               |
| Sialkot               | Town, Sialkot District                             | 32° 30'      | 74° 32'       |
| Sibi                  | Town, Sibi District                                | 29° 33'      | 67° 54'       |
| Sidhnai               | On Ravi River, Multan District                     | 30° 11'      | 72° 33'       |
| Sikaram               | Peak, Safed Koh Range, Kurram                      | 34° 02'      | 69° 57'       |
| Siran Nullah          | Hazara District                                    | 34° 20'–35'  | 73° 10'–20'   |
| Skardu                | Baltistan  | 35° 17'      | 75° 38'       |
| Sodhi                 | Salt Range, Sarghoda District                      | 32° 35'      | 72° 17'       |
| Sohtagan              | Western Chagai                                     | 28° 03'      | 62° 50'       |
| Sonmiani              | Las Bela   | 25° 25'      | 66° 35'       |
| Soon Valley           | Salt Range   | 32° 37'      | 72° 12'       |
| Sorab                 | See Surab  |              |               |
| Spezand               | Northern Kalat                                     | 29° 58'      | 66° 55'       |
| Sujawal }             | Thatta District                                    | 24° 36'      | 68° 05'       |
| Sojawal }             |  |              |               |
| Sonari Lake           | See Sunari   |              |               |
| Sukkur                | Town, Sukkur District                              | 27° 42'      | 68° 52'       |
| Suleimanki            | Barrage on Sutlej River                            | 30° 24'      | 73° 52'       |
| Sumbal Pani           | Kala Chitta  | 33° 37'      | 72° 23'       |
| Sunari                | Lake in Sanghar District                           | 26° 02'      | 69° 07'       |
| Suntsar               | South west Mekran                                  | 25° 30'      | 62° 00'       |
| Surab }               | Central Kalat                                      | 28° 29'      | 66° 15'       |
| Sorab }               |  |              |               |
| Takatu }              | Quetta District                                    | 30° 23'      | 67° 07'       |
| Takhatu }             |  |              |               |
| Takht-i-Suleiman      | Boundary, Baluchistan and Dera Ismail Khan         | 31° 36'      | 69° 59'       |
| Takkar                | Limestone outcrop in Khairpur State                | 27° 15'      | 68° 49'       |
| Talaganj              | Salt Range, Campbellpur District                   | 32° 56'      | 72° 25'       |
| Tando Mohammed Khan   | Hyderabad District                                 | 25° 07'      | 68° 31'       |
| Tank }                | Dera Ismail Khan                                   | 32° 13'      | 70° 22'       |
| Tonk }                |  |              |               |
| Tarbat                | See Turbat   | 25° 59'      | 63° 05'       |
| Tarbela               | Mardan and Hazara Boundary                         | 34° 07'      | 72° 49'       |
| Tarinda Mohammed Puna | Muzaffargarh District: not located                 | 29° 30'      | 71° 02'       |
| Tarki }               | Salt Range, Jhelum District                        | 33° 03'      | 73° 26'       |
| Traki }               |  |              |               |
| Tatepur               | Multan District                                    | 30° 13'      | 71° 39'       |
| Tatta }               | Town, Thatta District                              | 24° 45'      | 67° 56'       |
| Thatta }              |  |              |               |
| Taunsa                | Barrage, Muzaffargarh and Dera Ghazi Khan Boundary | 30° 42'      | 70° 46'       |
| Taxila                | Rawalpindi   | 33° 43'      | 72° 49'       |
| Teru                  | Pass, Chitral/Gilgit Boundary                      | 36° 13'      | 72° 44'       |
| Thal                  | Western Kohat District                             | 33° 22'      | 70° 33'       |
| Thana Bula Khan       | Dadu District                                      | 25° 21'      | 67° 51'       |
| Thandiani             | Hazara District                                    | 34° 14'      | 73° 22'       |
| Thatta                | See Tatta  |              |               |
| Tirich Mir            | Peak, Chitral                                      | 36° 14'      | 71° 49'       |
| Toba Kakri }          | Fort Sandeman, north western Baluchistan           | 31° 12'      | 67° 51'       |
| Toba Kaka }           |  |              |               |
| Toba Tek Singh        | Lyallpur District                                  | 30° 57'      | 72° 28'       |
| Torghar               | Hills, Fort Sandeman                               | 31° 15'      | 68° 30'       |
| Tori                  | Jacobabad District                                 | 28° 09'      | 69° 05'       |
| Traki                 | See Tarki, Salt Range, Jhelum District             | 33° 03'      | 73° 26'       |
| Tret                  | Murree Foothills                                   | 33° 51'      | 73° 19'       |
| Trimmu                | Jhang District, Barrage on Chenab River            | 31° 11'      | 72° 08'       |
| Turbat                | See Tarbat, south western Mekran                   | 25° 59'      | 63° 05'       |
| Uch }                 | Bahawalpur District                                | 29° 14'      | 71° 04'       |
| Uch Sharif }          |  |              |               |
| Uch Hali              | Lake, Mianwali District, Salt Range                | 32° 33'      | 72° 01'       |
| Umarkot }             | Tharparkar   | 25° 22'      | 69° 44'       |
| Umerkot }             |  |              |               |
| Urak }                | Valley, Quetta District                            | 30° 16'      | 67° 11'       |
| Uruk }                |  |              |               |
| Ushu                  | Swat Kohistan                                      | 35° 32'      | 72° 09'       |
| Utrot }               | Swat Kohistan                                      | 35° 29'      | 72° 27'       |
| Utror }               |  |              |               |
| Utzu                  | Southern Chitral                                   | 35° 30'      | 71° 40'       |
| Vihari }              | Multan District                                    | 30° 03'      | 72° 22'       |
| Vehari }              |  |              |               |



| Name          | Approximate Location                         | Coordinates  |               |
|---------------|--|--------------|---------------|
|               |  | Latitude (N) | Longitude (E) |
| Wah           | Campbellpur District                         | 33° 48'      | 72° 43'       |
| Walhar        | Southern Rahimyar Khan District              | 28° 11'      | 69° 59'       |
| Wam           | Northern Sibi District                       | 30° 27'      | 67° 43'       |
| Wana }        | South Waziristan                             | 32° 18'      | 69° 34'       |
| Wano }        |  |              |               |
| Warah         | Larkana District                             | 27° 26'      | 67° 48'       |
| Warsak        | Mohmand Agency                               | 34° 09'      | 71° 25'       |
| Wazirabad     | Gujranwala District                          | 32° 24'      | 74° 08'       |
| Yarkhun       | Nullah and Yarkhun Village, northern Chitral | 36° 47'      | 73° 02'       |
| Yakh Tangai   | Swat   | 34° 55'      | 72° 38'       |
| Yasin         | North western Gilgit                         | 36° 22'      | 73° 20'       |
| Yazman        | Cholistan                                    | 29° 08'      | 71° 44'       |
| Yusuf Khel    | Mohmand Agency                               | 34° 24'      | 71° 22'       |
| Zahirpir      | Rahimyar Khan District                       | 28° 48'      | 70° 32'       |
| Zambaza Range | Hills, Zhob District                         | 31° 03'      | 69° 24'       |
| Zarghun       | Peak, Quetta and Sibi Boundary               | 30° 30'      | 67° 32'       |
| Zhob          | River, north east Baluchistan                | 31° 45'      | 69° 50'       |
| Zizri         | Sibi District, Baluchistan                   | 30° 17'      | 67° 42'       |
| Ziarat        | Northern Sibi, Baluchistan                   | 30° 22'      | 67° 44'       |

# GLOSSARY OF VERNACULAR TERMS

*Bazaar* A commercial and retail vending region of a town or city.

*Ber* Thorny trees or shrubs of the *Zizyphus* genus, which bear a small drupe-like fruit. There are wild and cultivated species, the latter being referred to as the Indian Plum.

*Chappati* A flat round pancake of oven-baked unleavened whole wheat flour.

*Chicks* A flexible curtain or roller blind made from reeds, generally used to protect windows and verandahs from the summer sun.

*Chukor* The Rock Partridge, *Alectoris graeca*.

*Dband* Generally applied to a non-perennial lake or pond subject to monsoonal inundation. The term is particularly applied to wet lands in Sind province.

*Gali* A term generally applied to mountain ridges or saddles in Hazara district. Not to be confused with the English term 'gully' meaning a ravine.

*Gujar* A nomadic tribe of sheep and cattle herders who migrate into the higher hills of Kashmir and Azad Kashmir each summer.

*Hakim* A country practitioner of herbal medicine and non-allopathic treatment of diseases.

*Jaman* *Eugenia jambolana*. An evergreen tropical tree which bears small black fruits in June.

*Jheel* Generally applied to a perennial lake, and more commonly used in the Punjab.

*Jhogi or Jogi* A caste of professional snake charmers or snake-catchers who are usually semi-nomadic.

*Khareze* A subterranean covered seepage channel or tunnel excavated by hand by means of regularly spaced vertical access shafts, which is designed to collect ground water seeping down valley slopes, for crop irrigation lower down the valley floor. The device is particularly developed in Baluchistan.

*Mirbar* A tribe or caste of professional fishermen confined mainly to Sind province.

*Mohanna* Another tribe of professional fishermen living mainly on the Indus river.

*Neem* *Melia azedarachta*. A tropical deciduous tree, bearing drupe-like fruit in June and July.

*Nullah* A valley or ravine.

*Pat or Patts* Smooth flat clay beds between sand-dunes, generally characterized by saline conditions and very sparse vegetation.

*Shikari* Any hunter of game, but more particularly applied to a local villager who makes this his profession and who acts as a guide to amateur sportsmen.

*Sumbal* *Bombax malabaricum*. The silk cotton tree. A large tropical deciduous tree profusely bearing fleshy scarlet flowers just before the new leaves sprout in April.

*Tehsildar* A Government Administrative Official, largely responsible for a sub-district roughly equivalent to a Canton or County.



## GLOSSARY OF TECHNICAL TERMS

- Adult** Sexually mature though in ungulates not necessarily exhibiting maximum horn growth.
- Aestivation** Spending part of the summer in a state of torpor akin to hibernation.
- Aggressive** Any mammal's behaviour which results in the withdrawal or submission of another animal.
- Agonistic** With particular reference to behavioural traits aimed at establishing intraspecific or interspecific dominance.
- Albinism** Lacking normal pigment or hair colouring. In extreme form with pinkish eyes and yellowish white pelage.
- Allopatric** Taxa that do not overlap geographically.
- Anal** Relating to the posterior opening or orifice of the alimentary canal.
- Anthrophilic** Referring to habitat preference of mammals which deliberately tend to live and associate near human dwellings.
- Anthropomorphic** Attributing human traits, attitudes or emotions to mammals without any scientific basis.
- Anti-tragus** The upward fold or leaf-like process at the base of the outer-margin of the ear pinna — especially in bats.
- Arboreal** Having a tendency to live or move in trees.
- Arcuate** Curved like a bow but arching outwards at the distal portion.
- Baculum** A rod-shaped bone which strengthens the penis in some mammalian forms and which often differs consistently from one closely-related species to the next, thus providing a valuable guide in the separation of sibling species.
- Baleen** Horny plates attached to the upper jaw of whales which act as sieves to strain food from sea water.
- Barrage** Headworks of irrigation system comprising a low dam with lock gates to restrict flow of water down stream.
- Bicuspid** Having two points, generally with reference to incisor teeth.
- Biome** A major zone or ecological sub-division in the northern hemisphere.
- Biotope** The smallest sub-division of the habitat equivalent to the ecological niche.
- Bipedal** Travelling or progressing on two limbs only.
- Brachyodont** Referring to teeth with closed roots and short crowns which cease to grow by the time they come into full use.
- Breeding season** The period of active reproduction of actual young — not necessarily the mating season in mammals with a long gestation period.
- Bunodont** Cheek teeth having crowns with rounded cone-like tubercles.
- Bursa** Literally a purse. A pocket-like fold on the outer margin of the ear pinna.
- Caecum** A blind pouch, often greatly elongated, of the alimentary canal.
- Calcar** A small cartilaginous spur which grows out from the heel of bats' hind feet and which helps to support the hind margin of the inter-femoral membrane.
- Canine** A large conical tooth located immediately posterior to the incisors and anteriorly to the pre-molars. It is particularly well developed in carnivorous mammals.
- Cannon Bone** The large metacarpal bone in ungulates which is the main weight supporting bone below the carpal joint.
- Carnassial** Teeth in carnivores which are enlarged to shear flesh, usually the last upper pre-molar and the first lower molar.
- Carpal** In the region of the knee.
- Carpal pad** The rubber-like pad or rounded cushion on the sole of the fore and hind feet of some mammals, which is located near the wrist and posterior to the plantar pad or pads.
- Cement** An outer layer or coating found in the teeth of some mammals exteriorly to the enamel layer. The roots of mammals' teeth are covered by cement.
- Cingulum** A ridge encircling the base of the exposed part of teeth, especially developed in insectivores.
- Cloaca** A chamber receiving both the rectum and urogenital ducts, opening to the exterior by a single orifice, found in a few shrew species.
- Commensal** Animals which are dependent upon man and consequently live in close proximity.
- Conch** Literally 'shell-like' usually descriptive of the curved outer fold of skin around ear opening (auditory meatus).
- Condyle** The spherical part of a ball and socket articulation between two bones.
- Condylar-basal length** The most commonly used measure of the total length of a skull taken from the anterior points of the pre-maxillae, between the first pair of incisors, to the posterior surfaces of the occipital condyles.
- Crepuscular** Active in conditions of half light, principally at dawn and dusk.
- Cusp** A projection on the biting surface of a tooth.
- Cuspidate** Characterized by cusps in contrast to flat crowned, especially in relation to the biting surface of teeth.
- Cutaneous** Relating to the skin area.
- Deciduous** Falling out naturally during life, usually at a specific period or season, e.g. antlers of deer, milk teeth of mammals.
- Delayed Implantation** Relating to a condition when the fertilized ovum floats freely in the uterus for some months undergoing only slow development and before attaching to the uterus and continuing to develop to birth.
- Dentine** The material forming the largest, central part of most teeth being softer than the outer coating of hard enamel.
- Diastema** A natural space in the tooth row between the incisors and cheek teeth.
- Digit** Finger or toe.
- Digital pad** The soft cushions or naked pads on the under surface of the tips of the digits of a mammal's foot.
- Digitigrade** The gait of an animal when it walks on its toes with the heel or wrist being well off the ground.
- Dimorphism** Of a species existing in two distinct types or forms, e.g. males and females of different size or pelage.
- Dipterous** Insects belonging to the order Diptera or single winged flies.
- Distal** Further from the point of origin or attachment or centre of the body.

- Dorsal** On the upper side of the body or same region as the back.
- Echo-location** Orientation by reference to echoes of emitted sound reflected off solid surfaces.
- Ecology** The relation of plants or animals to their total environment.
- Enamel** The hard, brittle and usually shiny outer covering of a mammal's teeth.
- Erectile** Capable of being erected usually by contraction of sub-cutaneous musculature.
- Erythrism** Colour variation in which black or brown pigment is replaced by red or orange.
- Falcate** Sickle shaped.
- Fecund** The condition of bearing offspring.
- Fluke** Half of whale's tail.
- Foliaceous** Leaf-like.
- Foramen** Opening in a bone for the passage of nerves, blood vessels or more rarely a muscle. Usually a rather small circular or elliptical orifice.
- Foramen magnum** The comparatively large hole at the base of a skull through which the spinal chord passes to the brain.
- Forearm** With particular reference to the length of the radius bone in bats.
- Fossorial** Living in burrows or holes in the ground.
- Free water** Standing or open water as opposed to the water contained in plant cell tissue.
- Frugivorous** Fruit eating.
- Fusiform** Shaped like a spindle or cigar, tapering at both ends and rounded.
- Gestation** The period it takes for a foetus to develop from fertilization of the ova to parturition. In the case of delayed fertilization of the ova after copulation or delayed implantation of the ova in the wall of the uterus, the same term is often used to describe the total interval from mating to parturition.
- Gregarious** Habitually feeding and living in groups larger than that of a female and her offspring.
- Guard hairs** Long hairs less numerous than and projecting beyond the contour hairs of the body. Often darkly pigmented.
- Gular** Pertaining to the throat region.
- Habitat** The natural surroundings in which a species occurs.
- Hallux** The first digit of the hind limb; the big toe.
- Halophytic** Of plants adapted or tolerant of soil with a high salinity.
- Hibernation** The state of an animal in winter in which metabolism is slowed down, respiration is normally shallower and body temperature generally drops to that of the surroundings.
- Hispid** With regard to pelage, having stiff, bristly or spine-like body hairs.
- Holarctic** Pertaining to a distribution pattern encircling the north pole in both New and Old Worlds.
- Hypsodont** Of teeth which are high crowned (above the gums) and thus able to withstand a great deal of wear, often with open ended roots which are continuously growing throughout the mammal's life.
- Incisor** The front teeth, borne on the pre-maxillae bones. It is a front or cutting tooth situated anteriorly to the canines.
- Inguinal** Of or in the groin.
- Insectivorous** Subsisting upon insects.
- Inter-femoral membrane** The tail membrane of bats situated between the femora or hind limbs.
- Inter narial** Situated between the external nasal orifices.
- Isabelline** Straw coloured or pale yellowish brown or blond.
- Lagomorph** A member of the order of rabbits, hares and pikas.
- Lancet** The erect, posterior part of the noseleaf of a Horse-shoe bat of the genus *Rhinolophus*, which is projected into a triangular point.
- Larynx** The organ of voice, a cartilaginous structure located at the upper end of the trachea.
- Lax** With reference to pelage, having soft, flexible hairs or body fur.
- Longitudinal** Running in a head and tail direction, lengthwise.
- Mammae** Milk-secreting organs usually arranged in pairs in the ventral surface of the body.
- Mandibular** Relating to the lower jaw usually referring to teeth.
- Masseter muscle** The large cheek muscle which raises and lowers the jaw in chewing.
- Maxilla** The principal bone of the palate or upper jaw and side of the face containing the canine and cheek teeth.
- Maxillary** In the upper jaw, usually referring to the cheek teeth.
- Melanism** Colour variation in which black pigment predominates to such an extent that the pelage of the animal is partly or entirely black.
- Mesic** Of plants or animals adapted to live in moist conditions.
- Metacarpal** The long bone joining the base of each finger to the wrist.
- Molars** Back teeth used for grinding food. These are permanent teeth not preceded by milk teeth as in the case of pre-molars.
- Monotypic** Pertaining to a genus which has only one species.
- Nominate race** A subspecies bearing the same name as the species and regarded as most fully possessing the characters according with those of the species as originally described.
- Nuchal** Lower neck or upper shoulder region.
- Occipital** Relating to the region at the posterior extremity of the skull above the foramen magnum.
- Occipital condyle** One of the characteristic two bony knobs at the base of the skull against which the first cervical vertebra articulates.
- Oestrus** The period during which a female mammal is sexually receptive to the male and in which fertile mating can take place.
- Oriental region** One of the major zoogeographical regions comprising southern Asia, including Indonesia and Borneo.
- Orthopterous** Insects belong to the order Orthoptera such as locusts, crickets and grasshoppers.
- Palatal foramen** A pair of elongated ovoid holes in the roof of the mouth visible in the pre-maxilla bones of the skull of a mammal when viewed ventrally.
- Palearctic region** The zoogeographical region comprising Europe, Northern Asia and North Africa.
- Parturition** Birth.
- Pastern** The elongated bone which comprises the first phalange of the foot of ungulates and which slopes between the toe and the base of the cannon bone.
- Pectoral** Pertaining to or situated upon the chest.
- Pelage** Fur, hair or wool covering a mammal's body.
- Pelagic** Living on the high seas out of sight of land.
- Perineal** Relating to the area between the anus and the generative organs.
- Phalanges** The bones which comprise the separate joints in



- a finger.
- Phalanx* One of the bones in a mammal's digit or finger.
- Pinna* External cartilaginous flap of ear, often referred to as conch for its likeness to a shell.
- Plantar pad* The main rubber-like cushion or pad on the sole of the foot of some mammals immediately behind the digits or toes. It is generally formed by the merging of the inter-digital pads.
- Plantigrade* Gait of a mammal when it walks on the full sole of its foot including the heel.
- Pollex* First digit or thumb on the fore-foot.
- Poly-oestrus* Having more than one successive reproductive cycle when ovulation occurs at regular intervals. Thus a recurring breeding period in female mammals.
- Pre-molar* Teeth situated anteriorly to the molars and which are preceded by deciduous or milk teeth in mammals. They are often difficult to distinguish from molars as they are partially modified for chewing food.
- Proximal* Closer to the point of attachment or origin. Thus nearer to the centre of the body.
- Pruodont* Curving outwards, having reference to the angle of the front teeth or incisors.
- Psammophilic* A dweller in soft sand-dune areas. Literally a lover of sand.
- Pterygoid bones* A pair of bones on the sides of the occiput, usually with prominent processes.
- Radius* One of the two bones of the forearm. Hence radio-metacarpal means between the radius and metacarpal bones.
- Ramus* Part of a bone or the whole, of a natural pair of bones.
- Rhinarium* The anterior naked part of the snout, usually a moist rugose pad surrounding the nostrils.
- Rostrum* The facial part of the skull in front of the orbits. Extended in certain dolphin species (Odontecete) into a narrow elongated snout.
- Rugose* Having a rough or crinkled surface.
- Rut* The pairing time of a species, especially when the gonads of the male are active in spermatogenesis and males actively pursue females and exhibit an aggressive tendency towards other males encountered.
- Sagittal crest* A ridge of bone situated along the medial axis of the cranium and associated with the temporal muscles when these are large enough to meet on the top of the skull.
- Saltatorial* Progressing by hops or jumps from the hind feet.
- Sella* The central portion of the noseleaf of bats of the family Rhinolophidae which is roughly saddle shaped and projects forward in a vertical plane from the flat horseshoe disc beneath.
- Sclerophyllous* Shrubs and trees adapted to resist drought by means of small thickish leathery leaves — often evergreen to permit growth resumption whenever moisture becomes available.
- Sibling species* Morphologically similar populations which are in fact reproductively isolated biological species.
- Solitary* A mammal which normally carries out its feeding and resting activities in isolation from others of the same species.
- Spatulate* Narrow at the base but flattened and broad in the distal portion; thus spoon-shaped.
- Steppe* A somewhat discontinuous grassland harbouring scattered shrubs or stunted trees.
- Sub-adult* Approaching maturity but not fully adult.
- Subcutaneous* Relating to the region immediately beneath the skin.
- Supraorbital* Ridges of bone, sometimes wide and flange-like situated along the upper rim of the eye-socket.
- Swamp* A permanently flooded region.
- Sympatric* Taxa that overlap geographically at least in some part of their range, especially applied to two different species.
- Tarsus* Equivalent to the ankle in the human foot but greatly elongated in mammals which are digitigrade in gait.
- Taxon* A systematic unit of unspecified rank. Thus it can be a family, a genus, or a species.
- Taxonomy* The placing of animals in their natural relationships.
- Territorial* Relating to a mammal's behaviour with respect to the area or region over which it normally carries out its foraging and rutting activity.
- Territory* Usually an area defended by a mammal against others of its own species.
- Tibia* The main bone of the lower leg from the knee to the heel.
- Tine* The branch or prong of an antler.
- Torpor* A state of sluggishness or inactivity.
- Tragus* A cartilaginous structure, usually small and elongated, found at the external opening of the ear in some bat species.
- Tricuspid* Teeth having three points.
- Tubercles* Small lumps.
- Tympanic bulla* The usually rounded bony capsule surrounding the middle and internal ear in many mammals. It is known as the auditory bulla and is in fact the inflated mastoid chamber and a conspicuous diagnostic feature in the classification of many sibling rodent and lagomorph species.
- Ungulate* A hoofed mammal.
- Unicuspid* Of a tooth, having a single cusp or cone.
- Uropatagium* The inter-femoral or tail membrane of bats.
- Ventral* In the region of the underside of the body appertaining to the abdominal side.
- Ventrum* The underside of the body excluding the extremities of the limbs or head and throat.
- Vertical* Running up and down the body at right angles to the axis of the spinal column.
- Vestigial* Small and imperfectly formed, disappearing.
- Vibrissae* Specialized sensitive bristles or stiff hairs, most developed in the region of the muzzle on the upper lips of mammals.
- Xerophytic* A plant or one of its parts which shows a capacity to withstand drought.
- Zygomatic arch* The narrow arched bones (cheek bones) on each side of the skull and situated below the eye.

# INDEX

- Abies pindrow* (tree) 114, 225–30  
*Acacia arabica* (tree) 9, 177, 227–29  
*Acacia jacquemontii* (thorn bush) 9, 179–84  
*Acacia modesta* (tree) 7, 8, 171, 207, 208, 227  
*Acacia senegal* (tree) 8, 191, 207, 208  
*Accipiter gentilis* 211  
     —see also Birds of prey  
*Acer caesium* (tree) 6, 89  
*Achras sapota* (fruit tree) 40, 41  
*Acinonyx jubatus* 158  
*Acomys* genus 269  
*Acomys cahirinus* 4, 8, 269, 270  
*Acomys dimidiatus* 269  
*Acrididae* (insects) 51, 249, 291  
*Adhatoda vasica* (shrub) 7, 8  
*aduncus*, *Tursiops* 311, 316, 317  
*aegagrus*, *Capra* 188  
*aegyptiacus*, *Rousettus* 4, 33, 35, 36, 46  
*aegyptiaca*, *Tadarida* 4, 35, 60, 61  
*Aepyceros melampus* 179  
*Aesculus indica* (tree) 89  
*Aestivation* 11, 19, 282  
*Afghan Hedgehog* 8, 11, 15, 16, 18, 19  
*Afghan Mole Vole* 4, 11, 12, 13, 243, 251, 295, 297, 300  
*Afghan Pika* 8, 11, 213, 214, 215  
*Africa* 49, 56, 76, 103, 106, 122, 127, 131, 138, 139, 147, 155, 180, 209, 233, 245, 258, 281, 285, 288, 293  
*Ahmed, Imtiaz* 160, 177  
*Ainsworth-Harrison, J.* 171, 175, 183, 187  
*ajax*, *Presbytis entellus* 88, 89  
*Akbar Kurshid* vii  
*albiventer*, *Petaurista* 218  
*Albizzia lebbek* (tree) 40, 227  
*Alexandrian Rat* 251  
*alexandrinus*, *Rattus rattus* 251  
*Alectoris graeca* (rock partridge) 113, 145, 147  
*Algeria* 54, 60, 104, 293  
*Alhagi camelorum* (shrub) 9, 12  
*Ali, Hamid* (Divisional Forest Officer) 110, 190  
*Ali, Syed Asad* vii, 189, 191, 198  
*Ali, Syed Babar* (World Wildlife Fund International Trustee) vii  
*Ali Murdan Khan*, Mausoleum of 37  
*Allactaga* genus 143, 240  
*Allactaga elater* 12, 13, 236, 241, 242, 243, 247  
*Allactaga euphratica* 245  
*Allactaga hotsoni* 236, 241, 242, 243, 244  
*Allactaga terradactyla* 13  
*Allactaga williamsi* 236, 241, 242, 245  
*Allium* species 205, 232, 292  
*Allopatrism* 107, 118, 121, 189, 217, 285, 315  
*Alopecurus* (grass) 6  
*Alpine dry steppe* 8, 119, 146  
*Alpine Willow* 169, 194  
*Alpine zone* 6, 107, 116, 119, 157, 230, 253, 298  
*Altai* 120, 194, 232, 237, 249, 254  
*Alticola* genus 108, 120, 147, 252, 297, 304  
*Alticola argentata* (*argentatus*) 298, 299  
*Alticola roylei* 6, 11, 13, 118, 217, 243, 252, 298, 300, 303  
*Alticola stoliczkanus* 252, 298, 299  
*Amb State* 89  
*American Museum of Natural History*, New York 270, 305  
*Amir*, His Highness the late Amir of Bahawalpur vii, 155, 156, 161  
*Amir Khan Mona*, Mausoleum of 58  
*ammon*, *Ovis* 203  
*Amphibia* 31, 51, 99, 127, 135  
*Anacanthotermes piacrocephalus* (termite) 103  
*Anal glands* 111, 122, 124, 136, 210, 211  
*Anderson's Shaw* 23, 25, 28  
*Anderson, J. A. W.* vii, 19, 23, 28, 36, 94, 109, 122, 123, 137, 140, 142, 143, 144, 152, 153, 158, 198, 216, 225, 239, 240, 245, 247, 249, 256, 269, 270, 275, 281, 285, 289, 294  
*Anemone* (forbe) 6  
*Anis, Haider Shah* 176  
*Anointing* 18  
*Anona squamosa* (bush) 40  
*Antarctica* 209, 306, 308  
*Antelope Rat* 281, 285  
*Anthia sexguttata* (beetle) 133, 140  
*Antelope* genus 177  
*Antelope cervicapra* 4, 14, 178  
*Antilopinae* 177  
*Ants* 93  
*Apluda aristata* (grass) 7, 187  
*Apodemus* genus 251, 252  
*Apodemus flavicollis* 252, 253, 255  
*Apodemus griseus* 255  
*Apodemus sylvaticus* 4, 6, 8, 14, 151, 237, 251, 252, 253, 254, 268, 280, 302, 303  
*Apple* (fruit tree) 130, 215, 249, 302, 319  
*Apricot* (fruit tree) 110, 113, 115, 130  
*Aquila chrysaetos* 213, 232  
*Aquila rapax* 152  
*Arabian Fruit Bat* 33  
*Arabian Hare* 209, 210, 213  
*arabicus*, *Lepus* 209, 210, 213  
*arabicus*, *Rousettus aegyptiacus* 33  
*Arbab Yahya* (forest ranger) 141, 145, 190, 247  
*Arctic Hare* 116  
*Arctic zone* 5  
*argali*, *Ovis ammon* 203  
*Arid subtropical zone* 8, 110  
*Aristida cyanantha* (grass) 7, 187  
*Aristida funiculata* (grass) 185  
*Aristida mutabilis* (grass) 179, 185  
*Arsenous oxide* 320  
*Artemesia maritima* (shrub) 8, 112, 198, 212, 231, 237, 280  
*Artemesia scoparia* (shrub) 8, 112, 212, 247  
*Arthropods* — invertebrates 25, 110, 129  
*ARTIODACTYLA* 163, 167, 204  
*Arundo donax* 9  
*Ascaris* species 162  
*Asellia* genus 42, 59  
*Asellia tridens* 4, 8, 36, 53, 57, 59  
*Ash Tree* 87  
*asiae-orientalis*, *Neomeris phocaenoides* 314  
*Asian Barbastelle* 4, 53, 63, 68, 75  
*Asiatic Lion* 156  
*Asiatic Society of Bengal* 1  
*Asiatic Wide-eared Bat* 4, 53, 63, 68, 75  
*Asiatic Wild Ass* 159, 160  
*Asio otus* 283  
*Assam* 74, 91, 114, 187  
*Astor Markhor* 10, 195, 196, 197  
*Astragalus* species (forbes) 12, 203, 205  
*Astragalus frigidus* 217  
*Astragalus zambakarensis* 203  
*Athene brama* 27, 257, 264  
*Athene noctua* 31, 240, 281, 285  
*Atlantic Bottle-nosed Dolphin* 316, 317  
*attenuata*, *Crociodura* 30, 31  
*aurea*, *Marmota caudata* 228, 230  
*aureus*, *Canis* 9, 12, 18, 23, 95, 98, 172, 180, 185  
*aureus*, *Marmota* 230  
*auritus*, *Hemiechinus* 4, 9, 15, 16  
*auritus*, *Plecotus* 81, 82  
*auropunctatus*, *Herpestes* 99, 132  
*Australia* 23, 41, 49, 56, 69, 106, 209, 218, 317, 318  
*Avicennia officinalis* 9, 152, 273, 313, 315  
*Axis* genus 172  
*Axis axis* 172  
*Axis porcinus* 4, 9, 172, 173  
*Ayub Khan, Gauhar* (Capt.) 204  
*Azad Kashmir* 37, 175, 186, 188, 213, 220, 223, 273  
*Babbler, Striated* 142  
*Baboons* 85–87  
*babu*, *Pipistrellus* 70, 74  
*Babur, Emperor* 4, 159  
*Bacculum* 81, 95, 100, 111, 131, 136, 209, 218, 226, 302, 303  
*Bactrachians* 17, 31, 51, 99, 127, 135  
*Badger* 4, 8, 122, 123, 248  
*Bagh-i-Jinnah Gardens* 38  
*Bahawalpur Zoo* 88, 96, 100, 123, 148, 149, 178  
*bailwardi*, *Colomyscus* 8, 216, 250, 252, 268, 271, 277, 278, 289  
*Balaenopteridae* genus 306  
*Balaenoptera musculus* 306  
*Balaenoptera physalus* 1, 306, 307, 312  
*Balaenopteridae* Family 306  
*Baleen plates* 306  
*Baltistan* 103, 106, 107, 112, 118, 146, 156, 169, 193, 194, 197, 217, 232, 280, 298, 299  
*Baluchistan Bear* 8, 108, 109  
*Baluchistan desert scrub* 8  
*Baluchistan Gerbil* 8, 105, 252, 254, 257, 277, 281  
*Bananas* 35, 40



- Bandicoot 4, 9, 165, 251, 257, 262, 271, 272, 274  
*Bandicota* genus 251, 271  
*Bandicota bengalensis* 4, 9, 165, 251, 257, 262, 271, 272, 274  
 Bangla Desh 91, 110, 170  
 Banyan tree 40  
 Barasingha Deer 4, 175  
*Barbastella barbastellus* 75  
*Barbastella leucomelas* 4, 53, 63, 68, 75  
*Barbastella darjelingensis* 75  
 Barberry 6, 186  
 Barking Deer 4, 7, 170, 171, 187  
 Barrage (irrigation) 309, 310  
 Barruel, Paul (artist) 2, 190, 197  
 Bats  
   Dormer's 74  
   Geoffroy's 64  
   Greater Yellow 77  
   Hairy-Armed 67  
   Lesser Yellow 77  
   Long-eared 81, 82  
   Long-fingered 65  
   Long-winged 83  
   Mouse-eared 63  
   Sheath-tailed 45  
   Sind 65  
   Tube-nosed 83  
   Whiskered 64  
   Wrinkle-lipped 61  
   Yellow Desert 76  
*Bauhinia alba* 39  
*Bauhinia variegata* 7  
 Bear 106  
 Beaver 218, 233  
 Beech Marten 4, 8, 111, 112, 113, 118, 121, 170, 216, 217, 238, 250, 261, 279, 281, 289  
 Bees 115, 123  
 Beetles 17, 21, 25, 31, 51, 62, 78, 79, 121, 129, 133, 140, 141, 249, 287  
 Beg, Mirza Azhar vii, 256, 263  
 Beg, Rahman vii, 161, 177  
 Bengal, Bay of 315  
 Bengal Fox 8, 18, 100, 101, 103, 104, 274  
*bengalensis, Bandicota* 4, 9, 165, 251, 257, 262, 271, 272, 274  
*bengalensis, Felis* 4, 6, 138, 149, 223, 255, 261  
*bengalensis, Vulpes* 8, 18, 100, 101, 103, 104, 274  
 Ben Nevis Mountain 24  
 Bent-winged Bats 83  
*Berberis baluchistani* 8, 249  
*Berberis ceratophylla* 6, 186  
*Berberis heteropoda* 6  
*Berberis lycium* 6  
*Betula utilis* (tree) 6, 107, 169  
 Bharal 6, 97, 157, 200, 201, 219  
 Bhutto, Mumtaz Ali 165  
*bicolor, Hipposideros* 57  
 Biddulph, Captain 80  
 Big brown bats 42, 65  
 Bighorn Sheep 12, 204  
 Birch 6, 107, 169  
 Birch Forest 6  
 Birch Mouse 236  
 Birds of Prey  
   Bonnelli's Eagle 212, 213  
   Booted Eagle 213, 216, 292, 299  
   Golden Eagle 213, 232  
   Goshawk 211  
   Hawks 49  
   Hobby 36  
   Kestrel 299  
   Kites 27, 58  
   Long-legged Buzzard 292  
   255, 259, 261, 265, 266, 270, 277, 282, 297, 299, 304, 324  
   Broad-beaked Dolphin 317, 318  
   *Bromus molle* (grass) 8  
   *Bromus tectorum* (grass) 8  
   Brown Bear 4, 6, 11, 106, 107, 299  
   Brown Rat 251, 255, 258, 262, 271  
   Brown Spiny Mouse 10, 251, 262, 266  
   Bubonic plague 260  
   *Bufo andersoni* (toad) 17, 135  
   *Bufo arenarius* (toad) 21  
   Bunodont teeth 13, 163, 164  
   Burhan ud Din (Shahzada or Prince) 199, 207  
   Burmese Goral 185  
   Burrowing Vole 302  
   Bush Rats 4, 8, 251, 267  
   *Butastur teesa* 291  
   *Buthus* species 19, 21, 29  
   Buzzards 291, 292  
   Caecum 13, 209  
   *cahirinus, Acomys* 4, 8, 269, 270  
   Cairo Spiny Mouse 4, 8, 269, 270  
   *Calatropis procera* (shrub) 291  
   Calcutta 1, 262, 273  
   Calcutta Zoo 166, 223  
   *Calligonum polygonoides* (shrub) 9, 182, 185, 283  
   Callipers 322  
   Callous 160, 190  
   *Calomyscus* genus 252, 276  
   *Calomyscus bailwardi* 8, 216, 250, 252, 268, 271, 277, 278, 279  
   Camel 10, 13, 190  
   Camel Spiders 133  
   Camel Thorn (shrub) 9, 12  
   Camouflage 14, 116, 345  
   *cana, Vulpes* 100, 101, 105, 244, 247, 285  
   Canadian Lynx 145  
   Canadian Wolf 95, 97  
   Candidae family 95  
   *Canis* genus 95  
   *Canis aureus* 9, 12, 18, 23, 95, 98, 172, 180, 185  
   *Canis lupus* 8, 95, 162, 177, 180, 208, 236  
   *Canis lupus chanco* 94, 95, 203, 206, 232  
   *Canis lupus pallipes* 95, 96, 183, 185, 212  
   Cannibalism 17, 19, 97, 278, 287, 289  
   *capaccinii, Myotis* 64, 65  
   Cape Dolphin 315  
   Cape Hare 4, 7, 8, 10, 13, 113, 147, 157, 209, 212  
   *capensis, Delphinus* 315  
   *capensis, Lepus* 4, 7, 8, 10, 13, 113, 147, 157, 209, 212  
   *capensis, Mellivora* 4, 8, 122, 123  
   *Capra* genus 188  
   *Capra aegagrus* 188  
   *Capra caucasica* 200  
   *Capra falconeri* 1, 6, 8, 9, 13, 147, 155, 157, 187, 188, 196, 197  
   *Capra f. cashmiriensis* 195, 196, 197  
   *Capra f. chialtanensis* 188, 190, 195, 200  
   *Capra f. falconeri* 10, 195, 196, 197  
   *Capra f. heptneri* 195  
   *Capra f. jerdoni* 10, 186, 188, 195, 198  
   *Capra f. megaceros* 195, 198  
   *Capra hircus* 4, 8, 9, 97, 155, 164, 181, 188, 189, 200  
 Birds of Prey (cont.)  
   Sparrow Hawk 228  
   Tawny Eagle 152  
   White-eyed Buzzard Eagle 291  
 Black Bear 108  
 Blackbuck 4, 14, 178  
 Black Finless Porpoise 9, 313  
 Black-naped Hare 8, 9, 10, 14, 103, 140, 142, 209, 210  
 Black Poplar Tree 6, 87  
 Black Rat 51, 133, 250, 251, 255, 258, 259, 267, 286  
 Black Squirrels 5, 6, 9, 15, 21, 102, 141, 153, 218, 220, 221, 223, 226, 229  
 Blanford, W. 105, 226  
*blanfordi, Jaculus* 11, 13, 241, 244, 245, 246, 293  
*blanfordi, Ovis orientalis* 206, 207  
*blanfordi, Paraechinus hypomelas* 8, 16, 22  
 Blanford's Fox 100, 101, 105, 244, 247, 285  
 Blanford's Jerboa 11, 13, 241, 244, 245, 246, 293  
*Blaps orientalis* 133  
*blasii, Rhinolophus* 4, 52, 54, 55, 56  
 Blasius' Horseshoe Bat 4, 52, 54, 55, 56  
 Blossom Bat 41  
 Blowhole, whale's 306, 309  
 Blue Bull 4, 6, 7, 14, 175, 176  
 Blue Pine 6, 8, 89, 110, 114, 198, 222, 223, 225, 301  
 Blue Sheep 6, 97, 157, 200, 201, 219  
 Blue Whale 306  
 Blyth, Edward 18, 20, 308  
*blythi, Myotis* 63, 65  
 Boar, Wild 7, 8, 9, 163, 164  
 Bobak Marmot 6, 228, 230, 232  
*bobak, Marmota* 6, 228, 230, 232  
 Bombay city 28, 37, 41, 51, 58, 62, 77, 228, 308  
 Bombay Natural History Society  
   Mammal Survey 1, 28, 30, 43, 77, 79, 128, 140, 258, 261, 270, 277, 282, 283  
   Mammal Specimen Collection 20, 28, 29, 30, 31, 40, 55, 57, 61, 66, 75, 139, 167, 225, 232, 253, 255, 259, 262, 265, 266, 277, 302, 324  
 Bonelli's Eagle 213  
*booduga, Mus* 251, 263, 264, 265  
 Booted Eagle 213, 216, 292, 299  
 Borax 320  
 Boreal forest zone biome 5, 145, 169  
 Borivili Park (India) 38  
 Borneo 77, 218, 314, 315  
*Boselaphus* genus 175  
*Boselaphus tragocamelus* 4, 6, 7, 14, 175, 176  
 Bot Fly — *Hypoderma* species  
*bottae, Eptesicus isabellinus* 65, 66  
 Bottle-nosed Dolphin 311, 316, 317  
 Bott's Serotine 65, 66  
 Bovidae family 175  
 Braham, Trevor H. vii, 186, 195  
 Brahui language 158  
 Brambell, D. (Curator, Regents' Park) 145, 200  
 Brandt's Hedgehog 8, 16, 21  
*breviceps, Kogia* 312  
 British Museum (Natural History) 24, 28, 30, 31, 40, 55, 57, 66, 67, 68, 69, 70, 74, 75, 105, 106, 117, 119, 134, 144, 145, 147, 150, 161, 204, 227, 240, 248,

- Capra ibex* 6, 13, 97, 147, 157, 188, 192  
*Capra ibex sibirica* 6, 188, 192  
*Capparis aphylla* (shrub) 208  
*Capparis decidua* (shrub) 8, 9  
*Caprinae* subfamily 185  
*caracal* subgenus 145, 147  
*caracal, Felis* 4, 8, 94, 138, 147, 148, 185, 208  
*Caragana ambigua* (shrub) 8  
 Caravan or chain of shrews 27, 28, 30  
*Cardiocraniinae* subfamily 238  
*Carissa* species (shrub) 7  
 CARNIVORA 95–158  
 Carruthers' Vole 304  
*carruthersi, Pitymys* 304  
*cashmiriensis, Capra falconeri* 195, 196, 197  
*Cassia fistula* 7  
 Catfishes 127, 310  
*catodon, Physeter* 312  
 Cats  
   Desert cat 8, 10, 12, 14, 117, 127, 138, 139, 212  
   domestic 138, 144, 151, 302  
   Dune cat 4, 10, 13, 14, 138, 139, 142, 240, 244  
   Fishing cat 4, 9, 138, 150, 151  
   Jungle cat 4, 8, 9, 12, 14, 138, 140, 212, 255, 257, 274, 276, 288, 291  
   Leopard cat 4, 6, 138, 149, 223, 255, 261  
   Pallas' cat 138, 144, 216, 217  
   Sand cat 4, 10, 13, 14, 138, 142, 240, 244  
 Caucasian Rur 200  
*caudata, Marmota* 6, 11, 147, 157, 216, 228, 229, 230  
*Cedrus deodara* (tree) 6, 86, 110, 111, 115, 216, 219, 223, 253  
*Cenchrus pennisetiformis* (grass) 179, 185, 208  
 Centipedes 30  
*Cephalopods* 312  
*Ceratophyllus* species (fleas) 232  
*Cercopithecidae* family 85  
*Ceriops tagal* (shrub) 9  
*cervicapra, Antelope* 4, 14, 178  
*cervicolor, Mus* 251, 263  
*Cervidae* family 14, 166, 167  
*Cervus* genus 174  
*Cervus duvauceli* 4, 175  
*Cervus elaphus* 5, 175  
 CETACEA 306–318  
 Ceylon 71, 72, 78, 93, 129, 135, 152, 155, 171, 226, 257, 265, 268, 273, 285, 287  
*ceylonicus, Pipistrellus* 70, 72  
 Chamois 6  
*chanco, Canis lupus* 94, 95, 203, 206, 232  
*Charronia* genus 114  
 Chaudhri Inayatullah Khan (Deputy Conservator of Forests) 165  
*chaus, Felis* 4, 8, 9, 12, 14, 138, 140, 212, 255, 257, 274, 276, 288, 291  
 Cheek pouches 88, 232, 236, 251, 276, 279, 280  
*cheesmani, Gerbillus* 4, 10, 143, 252, 281, 285, 292, 293  
 Cheetah 158  
 Chenab River 28, 126, 136, 152, 165, 174, 310  
*Chenopodiaceae* 244, 257, 258, 292  
*Chenopodium album* 8  
*chialtensis, Capra falconeri* 200  
 Chicory 231  
 Chiku (fruit) 40, 41  
 Chilgoza pine 8, 86, 87, 197  
 Chiltan Goat 188, 190, 195, 200  
 Chinar (tree) 82  
 Chinese Birch Mouse 6, 236, 237, 243, 251, 253  
 Chinese Turkestan 205, 207, 217, 237, 249, 261, 281, 291, 298  
 Chinkara 1, 4, 8, 11, 14, 142, 148, 158, 180, 181, 183, 184  
 Chipmunk 218  
 CHIROPTERA 32–84  
 Chitin 41  
 Chittagong Hill tracts 110  
 Cholistan Desert region 5, 9, 16, 71, 104, 122, 134, 139, 141, 148, 149, 179, 184, 210, 264, 282  
 Chough (bird) 194  
 Chukor partridge 113, 145, 147  
 Chumbi Valley 203  
 Cicadas (insects) 115  
*Cicer arietum* (leguminous crop) 103  
*cinereus, Eupetaurus* 221, 225  
 Cingulum 79, 95  
*Cirrhinia mrigala* (fish) 310  
*Citrullus colocynthis* (plant) 185, 228  
*Citrullus vulgaris* (plant) 103, 104, 293  
 Civets 103, 127  
*Clematis gouriana* (shrub) 6, 7  
 Clifton Zoological Gardens 247  
 Cobra 123, 135, 141, 260, 274, 288  
 Cockchafers 69  
 Cockroaches 27, 140, 228  
 Coffee 268  
 Cold desert 6, 201, 204, 243  
 Coleoptera 17, 21, 25, 31, 51, 62, 78, 79, 121, 129, 133, 140, 141, 249, 287  
 Collared Hedgehog 15  
 Collared Pika 8, 11, 213, 214, 215  
 Coluber 141  
*Columba leuconata* 147  
*Columba livia* 140  
 Commensal habit 258, 262, 281, 286  
*Commiphora mukul* (bush) 8  
 Common Dolphin 315  
 Common Finback Whale 1, 306, 307, 312  
 Common Noctule 63, 67  
 Common Otter 4, 124  
 Common Pipistrelle 63, 70  
 Common Red Fox 8, 100, 101, 285  
 Common Rorqual 1, 306, 307, 312  
 Common Serotine 63, 65, 67, 68  
 Common White-toothed Shrew 4, 23, 24, 29  
*constantina, Felis* 138  
*Contraceptum lobulatum* (endoparasite) 312  
 Coot 152  
 Coprophagy 13, 213, 216  
 Corbet, Dr 305  
*coromandra, Pipistrellus* 70, 71  
*Corvus splendens* 135  
*Cotoneaster* species 7  
 Cottonseed 257  
 Crab, Fiddler 274  
 Crag Martins 51  
 Crane flies 99  
*craspedotis, Lepus* 213  
*crassicaudata, Manis* 4, 8, 91, 92  
*crassus, Meriones* 8, 252, 288, 292  
 Crayfish 125, 127  
 Crepuscularity 213  
 Crete 190  
 Crested Lark 17  
 Crested Porcupine 233  
*Cricetidae* family 250, 276  
*Cricetulus* genus 279  
*Cricetulus migratorius* 4, 8, 11, 13, 113, 120, 121, 147, 217, 250, 251, 278, 279, 280, 292, 322  
 Crickets 17, 19, 27, 110, 140, 290  
*Crocidura* genus 25, 29  
*Crocidura attenuata* 30, 31  
*Crocidura bubricosa* 31  
*Crocidura fulliginosa* 30, 31  
*Crocidura lencodon* 29  
*Crocidura pergrisea* 23, 28, 30  
*Crocidura portali* 30  
*Crocidura russula* 4, 23, 24, 29  
*Crocidura suaveolens* 29  
 Crocodile 312  
 Crow 58, 135  
 Crump, C.A. 62, 67, 258  
 Crustacea 30, 87, 225  
 Cunningham, Edward 93  
*Cuon* genus 106  
*Cuon alpinus* 106  
 Currants (wild) 169  
 Custard Apple (tree) 40  
 Cuttle fish 314, 316  
 Cutworms 287  
*cycleros, Ovis ammon* 203  
*Cymbopogon jwarancusa* (grass) 179  
*Cynopterus* genus 33, 40  
*Cynopterus sphinx* 40  
*Cyperus capillaris* (grass) 161  
 Cyprus 16, 18, 271  
*Cystanche tubulosa* (plant) 185  
 Dacca city 262  
 Daniel, Joseph C. vii  
 Dastagir, Colonel 177, 198  
*dasyurus, Gerbillus* 281  
 Date palm 34, 41, 110, 227  
 Decapods 12  
 Deccan 20, 45, 158, 177, 257, 268, 287  
 Deciduous forest biome 5  
 Deer  
   Barking deer 4, 7, 170, 171, 187  
   Hog deer 4, 9, 172, 173  
   Kashmir red deer 5, 175  
   Musk deer 5, 6, 14, 167, 168  
   Swamp deer 4, 175  
 Delayed implantation of ovum 48, 55, 74, 108, 113, 118, 120, 125  
*Delphinidae* family 314  
*Delphinus* genus 314  
*Delphinus capensis* 315  
*Delphinus delphis* 315  
*Delphinus dussumieri* 315  
*Delphinus tropicalis* 315  
 Deodar (tree) 6, 86, 110, 111, 115, 216, 219, 223, 253  
 Deosai Plateau 107, 193, 194, 230, 303  
 Desert cat 8, 10, 12, 14, 117, 127, 138, 139, 212  
 Desert hare 210  
 Desert hedgehog 4, 9, 15, 16  
 Desert (Indian) jird 9, 99, 103, 140, 141, 216, 231, 252, 257, 258, 283, 288, 289, 290  
 Desert scotophil 9, 11, 67, 68, 77, 78  
 Desert survival 10–14  
*Desmodontidae* 49  
 Dhole 106  
 Dhoob (grass) 18  
 Diadem Rat Snake 258, 279, 285, 288, 291  
 Diatoms 307  
*Digitaria bicornis* (grass) 208  
*dinniki, Felis lynx* 145  
*Diploda* 30



- Dipodidae* family 236  
*Dipodinae* subfamily 240  
*Diptera* 27, 44, 49, 67, 71, 79  
*Dipticus maculatus* (fish) 125  
Dobson, G. E. 76  
*Dodonea viscosa* (shrub) 7, 8  
Dogs  
    domestic 97, 100, 123, 130, 152, 155, 172, 232, 235  
    wild 95  
Dolphins  
    Bottle-nosed Dolphin 316  
    Cape Dolphin 315  
    Electra Dolphin 318  
    Indian Broad-beaked Dolphin 318  
    Indus Dolphin 308  
    Plumbeous Dolphin 315  
Domestic cats 138, 144, 151, 302  
Donkey, domestic 12, 137, 155  
Dormer's Bat 70, 74  
Dormouse 4, 8, 11, 248  
*Dorionum roylei* (forbe) 302  
*Draba trinervia* (forbe) 6  
Drumming of hind feet 216, 231, 291, 292  
Drummond, David vii  
*Dryomys* genus 248  
*Dryomys nitedula* 4, 8, 11, 248  
Dublin Zoo 149  
Ducks 152  
Dudley-Woodberry, Mrs J. 130, 131  
Duncan Zoo (Vancouver I.) 39  
Dune Cat 4, 10, 13, 14, 138, 142, 240, 244  
*Duplicidentata* suborder 209  
*duvauceli*, *Cervus* 4, 175  
Dwarf three-toed Jerboa 10, 11, 13, 236, 238, 239  
Dwarf Palm 8, 110, 207  
Eagles  
    Bonnelli's Eagle 213  
    Booted Eagle 213, 216  
    Golden Eagle 170, 199, 213, 216, 232, 233  
    Tawny Eagle 152  
Earthworms 17, 297  
Eastern Bottle-nosed Dolphin 316  
Eates, Kenneth R. vii, 123, 308  
*Echis carinatus* 12, 13, 258, 271, 283  
Echo-location (natural) 23, 32, 55, 60, 70, 310  
Ectoparasites 36, 38, 231, 232, 322  
Edwards, Mrs Sophie C. 221  
*edwardsi*, *Herpestes* 9, 18, 21, 131, 132, 133, 134, 258, 288  
Eggplant 274  
Egyptian Fruit Bat 4, 33, 35, 36, 46  
Egyptian Wrinkle-lipped Bat 4, 35, 60, 61  
Eidelweise (forbe) 299  
Eland 175  
*elaphus*, *Cervus* 5, 175  
*elater*, *Allactaga* 12, 13, 236, 241, 242, 243, 247  
Elburz Mountains 189, 214, 254, 291  
*Eleagnus hortensis* (shrub) 23, 106, 110, 113, 137  
Electra Dolphin 317, 318  
*electra*, *Lagenorhynchus* 317, 318  
*Eleusine flagillifera* (grass) 161, 208  
*elliotti*, *Golunda* 4, 8, 251, 267, 268  
*Ellobius* genus 295  
*Ellobius fuscocapillus* 4, 11, 12, 13, 243, 251, 295, 297, 300  
*Ellobius talpinus* 295, 297  
*emarginatus*, *Myotis* 64  
*Emballonuridae* family 45, 63  
Endoparasites 151, 162, 216, 312  
Endrin (insecticide) 165  
*Enneapogon persicum* (grass) 8  
*entellus*, *Presbytis* 6, 85, 86, 88  
*Ephedra intermedia* (shrub) 8  
*Ephedra nebrodensis* (shrub) 8  
*Eptesicus* genus 42, 65  
*Eptesicus bobrinskii* 67  
*Eptesicus bottae* 66, 67  
*Eptesicus fuscus* 67  
*Eptesicus isabellinus* 65, 66  
*Eptesicus nasutus* 35, 65, 66, 76  
*Eptesicus ognevi* 67  
*Eptesicus serotinus* 63, 65, 67, 68  
*Equidae* family 159  
*Equus* genus 159  
*Equus asinus* 159  
*Equus hemionus* 159, 160  
*Eragrostis* spp. (grass) 18  
*Eragrostis cynoseurioides* (grass) 274, 276  
*Eragrostis tef* (grass) 9  
*Eremaelurus thinobius* 4, 10, 13, 14, 138, 142, 240, 244  
*Eremurus* (plant) 213, 231, 303  
*Eremurus aurantiacus* (plant) 8, 235  
*Eremurus stenophyllus* (plant) 8  
*Erinaceidae* family 15  
*Erinaceus europus* 17, 18  
*Eristicophis mcMahonii* 12, 240, 244, 247, 285  
Ermine 4, 6, 112, 116, 117, 118, 217, 238, 299  
*erminea*, *Mustela* 4, 6, 112, 116, 117, 118, 217, 238, 299  
*Eryngium billardieri* (shrub) 8  
Erythrinism 18, 133, 144  
*Eryx conicus* 13, 14, 143, 240, 244, 247  
*Eryx johani* 13, 14, 143, 240, 244, 247  
*Eryx tartaricus* 276, 283, 285  
Ethiopian faunal region 4, 34  
Etruscan Shrew 1, 4, 23, 24, 25, 27  
*etruscus*, *Suncus* 1, 4, 23, 24, 25, 27  
*Eugenia jambolana* (tree) 37, 40  
*Eupetaurus* genus 225  
*Eupetaurus cinereus* 221, 225  
*Euphorbia caducifolia* (shrub) 8, 257, 268  
*Euphorbia kanaorica* (forbe) 6  
Euphratic Poplar Tree 9, 174  
Euphratic Viper 271, 279  
*europaeus*, *Lepus* 210, 211  
Evaporative cooling 11  
Facultative hypothermia 11, 240, 247  
Faeces (faecal pellets) 168, 169, 172, 177, 182, 185, 222, 235, 299, 322, 323  
*falconeri*, *Capra* 1, 6, 8, 9, 13, 147, 155, 157, 187, 188, 196, 197  
False teats 44, 45, 50, 55, 58  
False Vampire (Indian) 49  
Fat reabsorption 44, 47, 48, 231  
Fat storage 10, 43, 239  
Fatepur Sikhri 44  
Fawn coloured Mouse 251, 263  
*Felidae* family 127, 137  
*Felis* genus 138  
*Felis bengalensis* 4, 6, 138, 149, 223, 255, 261  
*Felis caracal* 4, 8, 94, 138, 147, 148, 185, 208  
*Felis chaus* 4, 8, 9, 12, 14, 138, 140, 212, 255, 257, 274, 276, 288, 291  
*Felis constantina* 138  
*Felis libyca* 8, 10, 12, 14, 117, 127, 138, 139, 212  
*Felis lynx* 4, 5, 6, 138, 145, 146, 170, 213  
*Felis manul* 138, 144, 216, 217  
*Felis margarita* 4, 10, 13, 14, 138, 142, 240, 244  
*Felis marmorata* 150  
*Felis sylvestris* 138  
*Felis viverrina* 4, 9, 138, 150, 151  
Fernando, Edward 142  
*ferrugineus*, *Herpestes edwardsi* 134  
*ferrumequinum*, *Rhinolophus* 4, 8, 9, 54, 59  
*fertilis*, *Hyperacrius* 302  
Fertilization, delayed 32, 64, 108, 113, 115, 118  
*Ferula* sp. 169  
*Ficus benghalensis* (tree) 104  
*Ficus carica* (tree) 7, 172  
*Ficus indica* (tree) 40  
*Ficus religiosa* (tree) 35, 40, 99  
Fiddler Crab 274  
Field Mouse 4, 6, 8, 14, 151, 237, 251, 252, 253, 254, 263, 264, 265, 268, 280, 302, 303  
*fimbriatus*, *Hylopates* 223  
Finbac Whale 1, 306, 307, 312  
Finless Porpoise 9, 313  
Fishing cat 4, 9, 138, 150, 151  
Fitzgibbon's Pigmy Jerboa 10, 11, 13, 236, 238, 239  
Five-striped Palm Squirrel 227  
Five-toed Jerboa 143, 240  
*flavicollis*, *Apodemus* 252, 253, 255  
*flavigula*, *Martes* 4, 6, 7, 111, 112, 113, 114, 221, 225, 255, 264  
Fleas 216, 232, 260  
'Flehmen' 192, 199, 206  
Flies, house 27, 228  
Flight 32, 221  
Flying Foxes 33, 38  
Flying Squirrels 218, 222, 223, 225  
*foina*, *Martes* 4, 8, 111, 113, 118, 121, 170, 216, 217, 238, 250, 261, 279, 281, 289  
Food stores 118, 121, 215, 217, 248, 250, 255, 273, 276, 278, 289, 290, 293, 295, 297  
Forearm (measurement) 32  
Forest Dormouse 4, 8, 11, 248  
Foxes  
    Blanford's Fox 100, 101, 105, 244, 247, 285  
    Common Red Fox 8, 100, 101, 285  
    Desert Fox 96, 100, 212, 285, 291  
    Hill Fox 8, 19, 100, 101, 102, 213, 281, 289, 295, 297  
    Indian Fox 8, 18, 100, 101, 103, 104, 274  
    Kashmir Fox see Desert Fox  
    Rüppell's Fox 4, 10, 13, 100, 101, 104, 247  
    Sand Fox 4, 10, 13, 100, 101, 104, 247  
    Siberian Fox 5  
    Tibetan Fox 5, 10, 100, 102  
    White-footed Fox 96, 100, 212, 285, 291  
*Fragaria vesca* (plant) 87  
*Francolinus pondicerianus* (partridge) 135, 148  
*Fraxinus excelsior* (tree) 87  
*Fraxinus xanthoxyloides* (tree) 8  
Free-tailed Bats 41, 60, 61  
Frog, tiger 21, 27, 99, 104, 135  
Frogs 99, 113, 125, 127, 141, 280

- Fruit Bats 32  
*Fulica atra* (bird) 152  
 Fulk, George W. 28, 257  
*fulvidiventris*, *Mus* 152, 153  
 Fulvous Fruit Bat 33, 36  
*fulvus*, *Hipposideros* 4, 8, 53, 56, 57  
*Funambulus* genus 226  
*Funambulus palmarum* 228  
*Funambulus pennanti* 227  
*fuscocapillus*, *Ellobius* 4, 11, 12, 13, 243, 251, 295, 297, 300
- 'Gad' 206, 207  
*Galeodes* species 19, 21, 103  
*Galeoidae* (sharks, dogfishes) 309  
*Galerida cristata* (bird) 17  
 Gall bladder 167  
 Ganges river 308  
*gangetica*, *Platanista* 308, 309  
 Gardezi, Ahmad Nawaz 154  
*Gasteropoda* 30  
 Gauhar, Ayub (Capt.) 204  
*Gavialis gangeticus* (reptile) 312  
*Gazella* genus 180, 181  
*Gazella gazella* 1, 4, 8, 11, 14, 142, 148, 158, 180, 181, 183, 184  
*Gazella subgutturosa* 8, 10, 11, 164, 180, 181  
 Geckos (reptiles) 51, 143  
 Genets 127  
 Geoffroy's Bat 64  
 Gerbil 13, 253, 254, 281, 285, 286, 288  
*Gerbillinae* subfamily 281  
*Gerbillus* genus 13, 254, 281  
*Gerbillus cheesmani* 4, 10, 143, 252, 281, 285, 292, 293  
*Gerbillus dasyurus* 281  
*Gerbillus gleadowi* 12, 252, 264, 281, 283, 284  
*Gerbillus nanus* 8, 105, 252, 254, 257, 277, 281  
 'Ghor-khar' 159, 160  
 Giant Day Jird 12, 13, 143, 250, 252, 284, 292, 293, 294  
 Giant Red Flying Squirrel 5, 6, 9, 218, 220, 221, 223, 229  
*giganteus*, *Pteropus* 4, 34, 38  
 Glands  
   anal glands 111, 122, 124, 136, 210, 211  
   caudal glands 105, 167  
   flank glands 25  
   gular pouch glands 45, 46, 47  
   inguinal glands 14, 180, 200, 203  
   lachrymal or pit glands 166, 169, 171, 177, 203  
   musk glands 23, 25, 169  
   pedal scent glands 169, 175, 177, 180, 186, 203  
   perineal glands 14, 122, 127  
   salivary glands 23, 29, 31  
   scent glands 23, 114  
   suborbital glands 14, 175, 177, 180, 182, 185, 200  
   sweat glands 12  
   swelling glands 69, 78  
*Glaucomys* genus 222  
 Gleadow, F. (Forest Officer) 283  
*gleadowi*, *Gerbillus* 12, 252, 264, 281, 283, 284  
*gleadowi*, *Rattus* 251, 254, 257  
 Gliding see Flying squirrels  
*Gliridae* family 247  
*Glis glis* 250  
 Goats 185, 188  
   domestic 97, 108, 110, 136, 155, 157, 188, 190, 198
- Gobi desert 240  
 Goitered Gazelle 8, 10, 11, 14, 142, 148, 158, 180, 181, 183, 184  
 Golden Eagle 170, 199, 213, 216, 232, 233  
 Golden Marmot 228  
*Golunda* genus 266  
*Golunda ellioti* 4, 8, 251, 267, 268  
 Gopher traps 319, 320  
*goral*, *Naemorhedus* 4, 6, 7, 167, 185, 186, 187  
 Goshawk 211  
 Gram (plant) 103  
 Grapes 129  
 Grasses  
   *Alopecurus* genus 6  
   *Apluda aristata* 187  
   *Aristida cyanantha* 7, 187  
   *Aristida funiculata* 185  
   *Aristida mutabilis* 179, 185  
   *Arundo donax* 9  
   *Bromus molle* 8  
   *Bromus tectorum* 8  
   *Cenchrus pennisetiformis* 185, 208  
   *Cymbopogon jwarancusa* 179  
   *Cyperus capillaris* 161  
   'Dhoob' 18  
   *Digiteria bicornis* 208  
   *Elueusine flagillifera* 161, 208  
   *Enneapogon persicum* 194, 198  
   *Eragrostis cynosurioides* 18, 161, 274, 276  
   *Eragrostis tef* 9  
   *Pennisetum orientale* 8, 198  
   *Pennisetum typhoides* 161, 180, 274  
   *Phragmites communis* 9, 153  
   *Poa alpina* 6, 203  
   *Poa pratensis* 203  
   *Saccharum munja* 155, 164, 173, 210  
   *Saccharum spontaneum* 9, 152, 164, 173  
   *Scirpus maritimus* 274  
   *Scirpus subulatus* 273  
   *Sorghum sudanense* 110, 180, 185, 257  
   *Stipa pennata* 8  
   *Tetrapogon villosa* 208  
   *Themeda anathera* 7, 187  
   *Typha angustata* 9  
   *Typha elephantina* 9  
 Grasshoppers 27, 140, 228, 283, 291  
 Great Blue Whale 306  
 Great Gerbil 12, 13, 143, 250, 252, 284, 292, 293, 294  
 Great Indian One-horned Rhinoceros 4, 159  
 Great Pamir Sheep 203, 204, 305  
 Greater Yellow Bat 9, 11, 67, 68, 77, 78  
 Greater Horseshoe Bat 4, 8, 9, 54, 59  
 Greater Mouse-tailed Bat 8, 10, 35, 36, 42, 43, 51  
 Greater Three-toed Jerboa 11, 13, 241, 244, 245, 293  
 Grey Goral 4, 6, 7, 167, 185, 186, 187  
 Grey Hamster 4, 8, 11, 13, 113, 120, 121, 147, 217, 250, 251, 278, 279, 280, 292, 322  
 Grey Langur 6, 85, 86, 88  
 Grey Long-eared Bat 81, 82, 250  
 Grey Mongoose 9, 18, 21, 131, 132, 133, 134, 258, 288  
 Grey Shrew 31  
 Grey Shrew, Pale 23, 28, 30  
*griffithi*, *Vulpes vulpes* 18, 19, 100, 101, 102, 213, 281, 289, 295, 297
- Grimwood, Ian (Maj.) vii, 99, 102, 110, 115, 123, 124, 149, 166  
 Gromov, I. M. 217, 298  
 Ground hogs 218  
*Gryllidae* 27, 140, 228, 283, 291  
*Grypomys* genus (synonym *Millardia*) 257  
*Grypomys gleadowi* 251, 254, 257  
 Gsell, A. (Maj.) 157  
 Guava (tree) 40, 41  
*Gunomys indicus* 271  
 Gupis, Raja of 157  
 Gyantse Bazaar 226  
*Gypaetus barbatus* 232
- Hafeez, Muhammed Ashraf (Divisional Forest Officer) 176, 179  
 Hairy-armed Bat 4, 67  
 Hairy-footed Gerbil 12, 252, 264, 281, 283, 284  
 Hakims 39, 48, 93  
*Halostachys caspica* (forbe) 244  
*Haloxylon ammodendron* (tree) 8, 9, 239  
*Haloxylon salicornicum* (forbe) 244  
 Hamburg Zoo 190  
 Hamid Ali (Divisional Forest Officer) 110, 190  
 Hamsters 276  
 Harbour Porpoise 313  
*hardwickei*, *Nesokia* 9, 11, 141, 251, 272, 274, 275, 296, 300  
*hardwickei*, *Rhinopoma* 4, 43, 44  
 Hardwicke's Hedgehog 4, 9, 15, 16  
 Hares  
   Arabian Hare 209, 210, 213  
   Black Naped Hare 8, 9, 10, 14, 103, 140, 142, 209, 210  
   Cape Hare 4, 7, 8, 10, 13, 113, 147, 157, 209, 212  
   Desert Hare 97  
   European Hare 210, 211  
*Harpiocephalus tubinaris* 53, 83  
 Harrison, J. Ainsworth 171, 175, 183, 187  
 Hassinger, Jerry 18  
 Hawaii 318  
 Hawks 49  
 Hayat, Mohammed (tracker) 184, 185  
 Heat radiation or dispersal 10-14, 210  
*heathi*, *Scotophilus* 9, 11, 67, 68, 77, 78  
 Hedgehogs  
   Afghan Hedgehog 8, 11, 15, 16, 18, 19  
   Brandt's Hedgehog 8, 16, 21  
   Collared Hedgehog 15  
   Indian Hedgehog 8, 15, 16, 20, 21  
   Long-eared Hedgehog 4, 9, 15, 16  
   Migratory Hedgehog 8, 16, 21  
*Helicopriss bucephalus* (beetle) 17, 21, 99, 141  
*Hemidactylus flaviridis* (reptile) 51  
*Hemiechinus* genus 15, 264  
*Hemiechinus auritus* 4, 9, 15, 16  
*Hemiechinus chorassanicus* 19  
*Hemiechinus megalotis* 8, 11, 15, 16, 18, 19  
*hemionus*, *Equus* 159, 160  
*Hemitragus* genus 188  
*Hemitragus jemlahicus* 188  
*hemprichii*, *Otonycteris* 63, 68, 79, 80  
 Hemprich's Long-eared Bat 63, 68, 79, 80  
*Herpestes* genus 132, 257, 260, 264  
*Herpestes auropunctatus* 99, 132



- Herpestes edwardsi* 9, 18, 21, 131, 132, 133, 134, 258, 288  
*Herpestes edwardsi ferrugineus* 134  
*Herpestes javanicus* 132  
Herpestinae subfamily 131, 132  
Hibernation 11, 18, 19, 45, 55, 56, 58, 66, 67, 73, 108, 111, 215, 221, 226, 231, 238, 240, 244, 248, 250, 281, 283, 302  
*Hibiscus esculentus* (vegetable) 274  
Hill, John Edwards vii, 74  
High Mountain Vole 108, 120, 147, 252, 297, 304  
Himalayan Black Bear 5, 6, 8, 11, 106, 107, 109, 230  
Himalayan Ibex 6, 188, 192  
Himalayan Lynx 146  
Himalayan Marmot 6, 228, 230, 232  
Himalayan moist temperate forest 6, 64, 82, 86, 109, 216, 219, 221, 223, 234, 253, 261, 301  
Himalayan Pipistrelle 70, 74  
Himalayan Rat 251, 259, 261  
Himalayan Rhesus Monkey 85  
Himalayan Tahr 188  
Hindu Kush Mountains 4, 294  
*Hippophae rhamnoides* (shrub) 8, 198  
Hipposiderinae subfamily 56  
*Hipposideros* genus 42, 56  
*Hipposideros bicolor* 57  
*Hipposideros cineraceus* 56, 57  
*Hipposideros fulvus* 4, 8, 53, 56, 57  
*hircus*, *Capra* 4, 8, 9, 97, 155, 164, 181, 188, 189, 200  
*Hirundo concolor* (bird) 51  
Hoffman, Robert vii, 230  
Hog Deer 4, 9, 172, 173  
Holarctic zone 63, 124, 295  
Holloway, Colin 45, 175  
Holly oak 110, 115, 207  
*Homo* genus 85–90  
Honey 115, 123  
Honey Badger 4, 8, 122, 123  
Hornets 135  
Horse chestnut tree 89  
Horseshoe Bats  
    Blasius' Horseshoe Bat 4, 52, 54, 55, 56  
    Greater Horseshoe Bat 4, 8, 9, 54, 59  
    Lesser Horseshoe Bat 52, 54, 55  
Hotson, J. E. B. (Col.) 34, 60, 270, 277, 296  
*hotsoni*, *Allactaga* 236, 241, 242, 243, 244  
Hotson's Five-toed Jerboa 236, 241, 242, 243, 244  
House Mouse 121, 133, 141, 237, 251, 252, 254, 262, 265  
House Rat 51, 133, 250, 251, 255, 258, 259, 267, 286  
House Shrew 4, 23, 25, 264  
House Sparrow 51  
Humpback Whale 308  
Hunza 6, 103, 107, 157, 193, 201, 205  
*hurrianae*, *Meriones* 9, 99, 103, 140, 141, 216, 231, 252, 257, 258, 283, 288, 289, 290  
*huttoni*, *Murina* 53, 83  
Hutton's Mole Rat 9, 12, 141, 251, 272, 274, 275, 296, 300  
*Hyaena* genus 135  
*Hyaena*, Striped 8, 96, 135, 136, 183, 191, 236  
*Hyaena hyaena* 8, 96, 135, 136, 183, 191, 236  
*Hyaenidae* family 135  
*Hylapetes fimbriatus* 223  
*Hyperacrius fertilis* 302  
*Hyperacrius wynnei* 302  
*Hystrix indica* 233  
Ibrahim, Mohammed (Shikari) 194, 199  
Ibex, see *Capra hircus* and *Capra ibex*  
*ibex*, *Capra* 6, 13, 97, 147, 157, 188, 192  
Ikramullah Khan (landowner) 187  
Imam Din 136  
Impala 179  
*Impatiens* species (forbe) 6  
Imprinting 14, 185  
Imtiaz Ahmed (Dr) 160, 177  
*indi*, *Platanista* 308, 309, 311, 314, 315  
Indian Broad-Beaked Dolphin 317, 318  
Indian Brown Spiny Mouse 10, 251, 262, 266  
Indian Bush Rat 4, 8, 251, 267, 268  
Indian Civet (Small) 4, 9, 14, 128, 324  
Indian Crested Porcupine 233  
Indian Desert Gerbil 9, 99, 103, 140, 141, 216, 231, 252, 257, 258, 283, 288, 289, 290  
Indian Desert Jird 9, 99, 103, 140, 141, 216, 231, 252, 257, 258, 283, 288, 289, 290  
Indian False Vampire 4, 7, 35, 49, 50  
Indian Gazelle 1, 4, 8, 11, 14, 142, 148, 158, 180, 181, 183, 184  
Indian Gerbil 12, 103, 104, 252, 281, 282, 285, 286, 289, 291, 322  
Indian Great One-horned Rhinoceros 4, 159  
Indian Hare 8, 9, 10, 14, 103, 140, 142, 209, 210  
Indian Hairy-footed Gerbil 12, 252, 264, 281, 283, 284  
Indian Hedgehog 8, 15, 16, 20, 21  
Indian Mole Rat 4, 9, 165, 251, 257, 262, 271, 272, 274  
Indian Mongoose (Small) 99, 132  
Indian Musk Shrew 4, 23, 25, 264  
Indian Ocean 306, 308, 317  
Indian Pangolin 4, 8, 91, 92  
Indian Pygmy Pipistrelle 70, 71  
Indian Pika 5, 6, 8, 118, 120, 209, 213, 216, 280, 298  
Indian Pipistrelle 70, 71  
Indian Porpoise 9, 313  
Indian Smooth-coated Otter 4, 9, 124, 125, 126, 310  
Indian Tiger Bullfrog 27, 135  
Indian Wild Boar 7, 8, 9, 163, 164  
Indian Wild Dog 106  
Indian Wolf 95, 96, 183, 185, 212  
*indica*, *Hystrix* 233  
*indica*, *Mangifera* 34, 39, 235  
*indica*, *Nesokia* 9, 12, 141, 251, 272, 274, 275, 296, 300  
*indica*, *Tatera* 12, 103, 104, 252, 281, 282, 285, 286, 289, 291, 322  
*indica*, *Viverricula* 4, 9, 14, 128, 324  
*Indigofera gerardiana* (shrub) 6  
Indus Dolphin 308, 309, 311, 314, 315  
Indus River 22, 25, 126, 134, 152, 155, 173, 175, 210, 274, 283, 291, 309, 314, 316  
INSECTIVORA 15–31  
*Inia* genus 308  
*Inia geoffrensis* 310  
*Iris* species 8  
Irshad, S. M. (Divisional Forest Officer) 109, 110  
*isabellina*, *Felis lynx* 146  
Isabelline serotine 65, 66  
*isabellinus*, *Eptesicus* 65, 66  
*isabellinus*, *Ursus arctos* 107  
Islam Khan (Divisional Forest Officer) 110, 207  
Isoptera 16, 93, 103  
IUCN Red Data Book 110  
Jackal 9, 12, 18, 23, 95, 98, 172, 180, 185  
*Jaculus* genus 245  
*Jaculus blanfordi* 11, 13, 241, 244, 245, 246, 293  
*Jaculus jaculus* 247  
*Jaculus orientalis* 245, 247  
Jaipur Zoo 98, 127  
Jaman tree 37, 40  
Jamot, Zulfikar Ali, Shah of 173  
Japan 29, 54, 70, 84, 218, 258  
*javanicus*, *Herpestes* 132  
*jemlahicus*, *Hemitragus* 188  
Jerdon, T. C. 1  
*jerdoni*, *Capra falconeri* 10, 186, 188, 195, 198  
Jerboa 240  
    Blanford's 236  
    Dwarf Three-toed 10, 11, 13, 236, 238, 239  
    Greater Three-toed 11, 13, 241, 244, 245, 246, 293  
    Hotson's 236, 241, 242, 243, 244, Persian 11, 13, 241, 244, 245, 246, 293  
    Pygmy 238  
    Small Five-toed 12, 13, 236, 241, 242, 243, 247  
    William's 236, 242, 245  
Jhelum river 22, 188  
Jird  
    Libyan 4, 8, 13, 105, 113, 143, 152, 250, 252, 258, 280, 282, 284, 288, 291  
    *Meriones* species 253, 281, 286, 288  
    Persian 8, 11, 13, 113, 216, 252, 277, 280, 284, 288  
    *Rhombomys* genus 252  
    Sundevall's 8, 252, 288, 292  
Jowar 110, 180, 185, 257  
*jubatus*, *Acinonyx* 158  
*Juglans regia* (tree) 221, 222, 225, 261  
*juldaschi*, *Pitymys* 304  
Jumping mice 236  
Junejo, Karim Dad 152, 174, 184  
Jungle Cat 4, 8, 9, 12, 14, 138, 140, 212, 255, 257, 274, 276, 288, 291  
*Juniperus* species 107, 280  
*Juniperus communis* 6  
*Juniperus macropoda* 8, 145, 197, 207, 214, 249  
*Juniperus polycarpus* 8, 169, 217  
Kabul Markhor 195, 198  
Kabul Zoo 145  
*kachhensis*, *Taphozous nudiventris* 47  
Kalat Region 106, 110, 112, 122, 189, 190, 207, 235, 256, 275, 280, 288, 291, 296  
Karachi Zoo 174  
Karakoram Mountains 193, 201, 217, 232, 280  
Kara Kum (USSR) 143, 148, 294  
Kathiawar (India) 4, 28, 47, 62, 75, 77, 129, 139, 177, 256, 257, 258, 266, 268, 283

- Kazakstan *see* Kazakhstan  
 Kazakhstan (USSR) 232, 240, 243  
 Kelaart's Pipistrelle 70, 72  
 Kerala State (India) 314  
 Kermani, W. A. (former Conservator of Forests) 184, 207  
 Khairpur, Mir of 152, 179  
 Khan, S. Amanullah (Maj.) vii, 152, 160, 169, 174, 175, 186, 190, 193, 198, 207, 310  
 Khan, Aslam (Brig.) 169, 175, 194  
 Khan Hamid (Retd.) (Inspector of Police) 169  
 Khan Ikramullah 187  
 Khan, Islam (Divisional Forest Officer) 207  
 Khan of Kalat 158  
 Khan, Malik Amir Mohammed, Nawab of Kalabagh 129, 154, 198  
 Khirgiz 205, 232  
 'Khur' 159, 160  
 Khush Wakht (Col.) 169, 193, 232  
 Khyber Valley 1, 198  
 King Fox 100, 101, 105, 244, 247, 285  
*kinneari*, *Rhinopoma* 43  
 Kirghiz (nomads) 205, 232  
 Klockinhoff, H. 198  
*Kogia* genus 312  
*Kogia breviceps* 312  
 Korea 54, 67, 115, 187, 218, 314  
 Korwa State (India) 158  
 Krebb, Mr 128, 137, 152, 164, 174, 176  
 'Kuchnar' tree 39  
*kuhli*, *Pipistrellus* 9, 36, 63, 70, 73  
*kuhli*, *Scotophilus* 76  
 Kuhl's Pipistrelle 9, 36, 63, 70, 73  
 Kuhnert, Mr 145  
 Kulan 159  
 Kulu Valley (India) 31, 115, 130, 203  
 Kumaon (India) 69, 74, 83, 222, 261, 275  
 Kurram Valley 22, 115, 120, 198, 210, 213, 214, 227, 249, 277, 280, 288  
 Kutch (India) 20, 43, 46, 75, 148, 159, 266  
  
 Laccadive Islands 317  
 Lacewings 55, 82  
 Lachrymal glands 166, 169, 171, 177, 203  
*Lacertidae* family 17, 21, 97, 104, 106, 110, 113, 121, 133  
 Ladakh (India) 119, 139, 144, 145, 146, 147, 159, 232, 254, 299  
*Lagenorhynchus* genus 317  
*Lagenorhynchus electra* 317, 318  
 LAGOMORPHA 13, 209–217  
*lagopus mutus* 116  
 Lahore Zoo 94, 95, 98, 108, 110, 111, 123, 126, 133, 137, 139, 154, 161, 170, 173, 174, 177, 180, 185  
 Lammergier (vulture) 232  
 Lancet 52, 55, 59  
 Langur 88  
 Lantana (shrub) 269  
 Large-eared Pika 213, 216, 217  
*Larus genei* 314  
*larvata*, *Paguma* 4, 7, 117, 129, 130, 131  
 Las Belas 20, 93, 123, 150, 190, 210, 234, 256, 306, 313  
*Latrodectus hasseltii* 12  
 'Laufschlag' 192, 208  
 Lay, Douglas vii, 62, 247, 282  
 Leaf-nosed Bats 52  
 Leaf-nosed Viper 12, 240, 244, 247, 285  
*leathemi*, *Sicista concolor* 236  
 Leech 27  
*Leggada booduga* 264  
*Leggada platythrix* 266  
*leisleri*, *Nyctalus* 4, 67  
 Lemmings 295  
 Leningrad Zoological Institute 305  
*lentiginosa*, *Sotalia* 315, 317  
*lentiginosa*, *Sousa* 315, 317  
 Leopard 5, 7, 8, 88, 153, 154, 188, 191, 208, 235  
     Snow Leopard 6, 153, 156, 170, 194, 199, 203, 232  
 Leopard Cat 4, 6, 138, 149, 223, 255, 261  
 LEPIDOPTERA 62, 64, 67  
*Leporidae* family 209  
*Leptadenis spartium* (bush) 9, 185  
*Lepus* genus 209  
*Lepus arabeus* 209, 210, 213  
*Lepus capensis* 4, 7, 8, 10, 13, 113, 147, 157, 209, 212  
*Lepus craspedotis* 213  
*Lepus europaeus* 210, 211  
*Lepus nigricollis* 8, 9, 10, 14, 103, 140, 142, 209, 210  
*Lepus timidus* 116  
*leschenaulti*, *Rousettus* 33, 36, 40, 79  
 Lesser Bandicoot Rat 4, 9, 165, 251, 257, 262, 271, 272, 274  
 Lesser Horseshoe Bat 52, 54, 55  
 Lesser Jerboa 11, 13, 241, 244, 245, 246, 293  
 Lesser Mouse-eared Bat 63, 65  
 Lesser Mouse-or Rat-tailed Bat 4, 43, 44  
 Lesser Noctule 4, 67  
 Lesser Shrew 6, 23  
 Lesser Yellow Bat 77  
 Libyan Jird 4, 8, 13, 105, 113, 152, 153, 250, 252, 258, 280, 282, 284, 288, 291  
*libyca*, *Felis* 8, 10, 12, 14, 117, 127, 138, 139, 212  
*libycus*, *Meriones* 4, 8, 13, 105, 113, 152, 153, 250, 252, 258, 280, 282, 284, 288, 291  
 Lice (ectoparasite) 232  
 Lichen 169, 203, 226  
 Lichies (fruit) 41  
 Lion 4, 155, 156  
*Liponycteris* subgenus 47  
*Lipotes* genus 308  
 Little Brown Bats 32, 42, 63, 68  
 Little Indian Field Mouse 251, 263, 264, 265  
 Little Indian Porpoise 9, 313  
 Lizards 17, 21, 97, 104, 106, 110, 113, 121, 133  
 Locust 106  
 London Zoo 108, 131, 144, 145, 160, 172, 183, 203, 204, 250, 270  
 Long-eared Bat 81, 82  
 Long-eared Hedgehog 4, 9, 15, 16  
 Long-fingered Bat 64, 65  
*longipes*, *Myotis* 64, 65  
 Long-tailed Hamster 8, 216, 250, 252, 268, 271, 277, 278, 289  
 Long-tailed Marmot 6, 11, 147, 157, 216, 228, 229, 230, 319  
 Long-winged Bat 42, 50, 83  
*Lonicera alpigena* (shrub) 6, 217  
*Lonicera heterophylla* (shrub) 169, 249  
 Lucerne (fodder crop) 244, 292  
 Ludhiana (India) 257  
  
*lupus*, *Canis* 8, 95, 162, 177, 180, 208, 236  
*Lutra* genus 124  
*Lutra lutra* 4, 124  
*Lutra perspicillata* 4, 9, 124, 125, 126, 310  
*Lutra perspicillata sindica* 125  
*Lutrinae* subfamily 124  
*Lutrogale* subgenus 125  
*Lycium barbarum* (shrub) 292  
*Lynx* subgenus 145  
*lynx*, *Felis* 4, 5, 6, 138, 145, 146, 170, 213  
*Lynx canadensis* 145  
*Lyroderma* subgenus 49  
*lyra*, *Megaderma* 4, 7, 35, 49, 50  
  
*Mabuya macularis* 21  
*Macaca* genus 85  
*Macaca mulatta* 6, 85, 86, 155  
*Macaca mulatta mcmahoni* 85, 86  
*Macaca mulatta villosa* 85  
 Macaque 85, 86  
 Macfadzean, W. 146  
*Machrobrachium malcolmsonii* (crustacean) 127, 310  
*Macrotis*, *Ochotona* 213, 216, 217  
 Madagascar 56, 218  
 Madyha Pradesh (India) 117  
 Magpie 222, 249  
 Maharashtra State (India) 51  
 Maize 86, 110, 177, 228, 235, 237, 238, 261  
 Malaysia 26, 28, 47, 51, 58, 77, 97, 114, 129, 133, 135, 273  
 Malayan Flying Fox 38  
 Malik Asad Khan 205, 207  
 Malik Muzzafar Khan 136  
 Mammal surveys 1  
*Mangifera indica* 34, 39, 235  
 Mango 34, 39, 235  
 Mangrove 9, 152, 273, 313, 315  
*Manidae* family 91  
*Manis* genus 91  
*Manis crassicaudata* 4, 8, 91, 92  
*Manis pentadactyla* 91, 94  
*manul*, *Felis* 138, 144, 216, 217  
 Manzur-ul-Haque (Retired Forest Officer) 103, 157, 193  
 Maple tree 6, 89  
 Marbled Cat 150  
 Marbled Polecat 4, 8, 112, 118, 120, 121, 244, 250, 279, 292, 295, 297  
 Marco Polo's Sheep 203, 204, 205  
 Marden, J. H. (Lt. Gen.) vii, 122, 142, 179  
*margarita*, *Felis* 4, 10, 13, 14, 138, 142, 240, 244  
 Markhor 1, 6, 8, 9, 13, 147, 155, 157, 187, 188, 196, 197  
*marmorata*, *Felis* 150  
*Marmota* genus 228  
*Marmota aureus* 230  
*Marmota bobak* 6, 228, 230, 232  
*Marmota caudata* 6, 11, 147, 157, 216, 228, 229, 230  
*Marmota monax* 231  
 Marmots 228  
 Marston, E. C. (Gen.) 190  
 Martens 111  
*Martes* genus 111  
*Martes americana* 113  
*Martes flavigula* 4, 6, 7, 111, 112, 113, 114, 221, 225, 255, 264  
*Martes gwatkinsi* 115  
*Martes foina* 4, 8, 111, 112, 113, 118, 121, 170, 216, 217, 238, 250, 261, 279, 281, 289  
*Martes martes* 113



- Maternal colonies 37, 44, 56, 60, 63, 64, 67, 69, 71, 72, 77, 82  
*mcmahoni*, *Eristicophis* 12, 240, 244, 247, 285  
*mcmahoni*, *Macaca mulatta* 85, 86  
*Medicago* species (forbe) 282  
Mediterranean climate 8, 235, 249, 279  
Mediterranean Pygmy Shrew 1, 4, 23, 24, 25, 27  
*megaceros*, *Capra falconeri* 195, 198  
*Megachiroptera* suborder 32, 322  
*Megaderma* genus 49  
*Megaderma lyra* 4, 7, 35, 49, 50  
*Megaderma spasma* 51  
*Megadermatidae* family 49  
*Megaptera* genus 308  
*Megaptera novaeangliae* 308  
Mekran coast 20, 22, 34, 56, 60, 93, 97, 120, 122, 133, 147, 158, 183, 190, 207, 214, 227, 245, 246, 263, 270, 275, 282, 287, 288, 290, 291, 293, 306, 308, 312, 313, 315, 317, 318  
Melanism 15, 21, 102, 141, 153, 220, 226  
*Meles meles* 122, 248  
*Melia azedarachta* (tree) 35, 104  
*Melia azedarach* (shrub) 35, 40, 235  
*Mellivora* genus 122  
*Mellivora capensis* 4, 8, 122, 123  
*Melolontha* species (cockchafers) 69, 249  
Melons 19, 22, 106, 225, 235, 264, 293  
*Meriones* genus 253, 281, 286, 288  
*Meriones crassus* 8, 252, 288, 292  
*Meriones erythrouus* 291  
*Meriones hurrianae* 9, 99, 103, 140, 141, 216, 231, 252, 257, 258, 283, 288, 289, 290  
*Meriones libycus* 4, 8, 13, 105, 113, 143, 152, 250, 252, 258, 280, 282, 284, 288, 291  
*Meriones persicus* 8, 11, 13, 113, 216, 252, 277, 280, 284, 288  
*Meriones meriones zarudnyi* 292  
*Mertensia tibetica* (forbe) 6  
Metad 251, 255, 256, 268  
*Microchiroptera* suborder 32, 41, 322  
*Microtinae* family 13, 243, 250, 295, 304  
*Microtus carruthersi* 304  
*Microtus fertilis* 302  
*Microtus juldaschi* 304  
*Microtus nivalis* 302  
*Microtus wynnei* 300  
Migration 52, 66, 69, 125, 127, 175, 221, 260, 274, 306, 308, 315  
Migratory Hamster 4, 8, 11, 13, 113, 120, 121, 147, 217, 250, 251, 278, 279, 280, 292, 322  
Migratory Hedgehog 8, 16, 21  
*migratorius*, *Cricetulus* 4, 8, 11, 13, 113, 120, 121, 147, 217, 250, 251, 278, 279, 280, 292, 322  
*millardia*, *Panthera pardus* 153  
*Millardia* subgenus 251, 255  
*Millardia gleadowi* 12, 251, 255  
*Millardia meltada* 251, 255, 256, 268  
Millet 161, 180, 274  
*Miniopterus* genus 83  
*Miniopterus schreibersi* 42, 50, 83  
Mir of Hunza 205  
Mir of Khaipur 152, 179  
Mir Ali Murad Talpur, Mir of Khaipur 152, 179  
Mir Mohammed Hassan (Deputy Ranger, Wildlife) 110  
Mirza, Zahid Beg vii, 3, 37, 44, 51, 53, 59, 119, 128, 168, 169, 176, 186, 200, 207, 220  
Mist nets 310, 322  
Mites (ectoparasites) 38  
Moghal 159, 193  
Mohalander Gardens 39  
Mohammed Ibrahim (Shikary) 194, 199  
Moisture conservation 10  
Mole crickets 17  
Mole rat 4, 9, 165, 251, 257, 262, 271, 272, 274  
Mole traps 319  
*Molossidae* family 60  
Monitor Lizard 228  
*Monothea buxifolia* (shrub) 8  
Montane temperate forest 6  
Morocco 54, 60  
*Morus alba* (shrub) 19, 99, 110, 166, 235  
*Moschinae* subfamily 167  
*Moschus* genus 167  
*Moschus moschiferus* 5, 6, 14, 167, 168  
Mosquitos 55, 58  
Mountain Steppe 8, 207, 212, 214, 226, 234  
Moufflon 206  
Mountford, Guy 22  
Mouse-like Hamster 8, 216, 250, 252, 268, 271, 277, 278, 289  
Mouse  
    Birch Mouse 236  
    Field Mouse 4, 6, 8, 14, 151, 237, 251, 252, 253, 254, 263, 264, 265, 268, 280, 302, 303  
    House Mouse 121, 133, 141, 237, 251, 252, 254, 262, 265  
    Spiny Mouse 4, 8, 10, 251, 262, 266, 269, 270  
    Wood Mouse 4, 6, 8, 14, 151, 237, 251, 252, 253, 254, 268, 280, 302, 303  
Mouse-tailed Bat 10, 41  
Mulberry tree 19, 99, 110, 166, 235  
Mullee (fish) 310  
Mumby, Wyn 158, 204  
Mumtaz Ali Khan (locust control entomologist) 106, 147, 184  
*Muntiacinae* subfamily 170  
*Muntiacus* genus 170  
*Muntiacus muntjak* 4, 7, 170, 171, 187  
Muntjak 4, 7, 170, 171, 187  
*Muridae* family 250, 251  
*Murinae* subfamily 251  
*Murina* genus 42, 83  
*Murina aurata* 84  
*Murina huttoni* 53, 83  
*Murina leucogaster* 84  
*Murininae* subfamily 83  
Murray, James A. 40, 258  
Murree Vole 302  
Murrel (fish) 127  
*Mus* genus 262  
*Mus booduga* 251, 263, 264, 265  
*Mus cervicolor* 251, 263  
*Mus fulvidiventrus* 263, 265  
*Mus musculus* 121, 133, 141, 237, 251, 252, 254, 262, 265  
*Mus platythrix* 10, 251, 262, 266  
*Mus saxicola* 266  
*Muscardinidae* family 247, 248  
*Muscardinus avellanarvis* 250  
*musculus*, *Balaenoptera* 306  
*musculus*, *Mus* 121, 133, 141, 237, 251, 252, 254, 262, 265  
Mushrooms 110, 255  
Musk Deer 5, 6, 14, 167, 168  
Muskrat 218  
Mussoorie (India) 68  
*Mustela* genus 116  
*Mustela altaica* 4, 5, 6, 112, 113, 116, 118, 119, 217, 238, 299  
*Mustela erminea* 4, 6, 112, 116, 117, 118, 217, 238, 299  
*Mustela kathia* 118  
*Mustela nivalis* 118  
*Mustelidae* family 111  
*Mustelinae* subfamily 111  
Myomorph 218  
*Myotis* genus 32, 42, 63, 68  
*Myotis blythi* 63, 65  
*Myotis capaccinii* 64, 65  
*Myotis emarginatus* 64  
*Myotis lanceus* 64  
*Myotis longipes* 64, 65  
*Myotis mystacinus* 6, 63, 64, 68  
*Myotis oxygnathus* 65  
Mysore (India) 62  
*Mysticeti* suborder 306  
*Mystus aor* (fish) 310  
*Naemorhedus* genus 185  
*Naemorhedus goral* 4, 6, 7, 167, 185, 186, 187  
*Naja naja* 123, 135, 141, 260, 274, 288  
Naked-bellied Sheath-tailed Bat 47  
Nana, Rohil F. vii, 165, 186, 188, 198  
Nangahar Province (Afghanistan) 51  
*Nannorrhops ritchieana* (palm) 8, 110, 207  
*nanus*, *Gerbillus* 8, 105, 252, 254, 257, 277, 281  
Nasirabad (India) 65  
*nasutus*, *Eptesicus* 35, 65, 66, 76  
*nayaur*, *Pseudois* 6, 97, 157, 200, 201, 219  
Nawab of Bahawalpur vii, 155, 156, 161  
Nawab Isa Khan's Mausoleum 60  
Nawab of Kalabagh 129, 154, 198  
Nearctic zone 250, 304  
Neem tree 35, 104  
Nematode (endoparasite) 66, 162, 216, 312  
*Neodon* subgenus 304  
*Neomeris* genus 313  
*Neomeris phocaenoides* 9, 313  
*Neomeris phocaenoides asiae-orientalis* 314  
*Nephelium litchi* (fruit tree) 41  
*Nesokia* genus 251, 274  
*Nesokia bengalensis* 4, 9, 165, 251, 257, 262, 271, 272, 274  
*Nesokia hardwickei* 9, 12, 141, 251, 272, 274, 275, 296, 300  
*Nesokia huttoni* 9, 12, 141, 251, 272, 274, 275, 296, 300  
*Nesokia indica* 9, 12, 141, 251, 272, 274, 275, 296, 300  
Nets and netting 310, 322  
Niches, ecological 9  
Nethammer, Jochem vii, 83, 106, 115, 121, 130, 220, 225, 255, 287, 299, 302  
*nigricollis*, *Lepus* 8, 9, 10, 14, 103, 140, 142, 209, 210  
*nigripictus*, *Felis manul* 144  
Nilghai 4, 6, 7, 14, 175, 176  
Nilgiri Hills (India) 28, 171, 268  
*nitedula*, *Dryomys* 4, 8, 11, 248  
*nitidus*, *Rattus* 251, 259, 261  
*nivalis*, *Microtus* 302  
*nivalis*, *Mustela* 118  
*noctula*, *Nyctalus* 63, 67  
Northern Palm Squirrel 227

- Norway Rat 251, 255, 258, 262, 271  
 Nose-leaf 52  
 Notch-eared Bat 64  
*novaeangliae*, *Megaptera* 308  
 Nutria 218  
*Nyctalus* genus 42, 67  
*Nyctalus leisleri* 4, 67  
*Nyctalus montanus* 4, 67  
*Nyctalus noctula* 63, 67  
*Nycticeius* genus 42, 76  
*Nycticeius pallidus* 66, 68, 76  
*Nyctinomus tragatus* 4, 35, 60, 61  
*Nycteribidae* (wingless flies) 36, 40  
*Nycteribosea gigantea* 38
- Ochotona* genus 113, 145, 213  
*Ochotonidae* family 209, 213  
*Ochotona hyperborea* 5  
*Ochotona macrotis* 213, 216, 217  
*Ochotona roylei* 5, 6, 8, 118, 120, 209, 213, 216, 280, 298  
*Ochotona rufescens* 8, 11, 213, 214, 215  
*Ochra* (vegetable) 274  
*Octolobus* subgenus 144  
*Octolobus manul* 144  
*Odontoceti* suborder 306, 308, 310  
 Oklahoma Zoo 94  
 Oldfield, Thomas J. 225  
*Olea cuspidata* (tree) 8, 171, 207  
 Olive, false 208  
 Olive, wild 8, 171, 207  
 Onager 159, 160  
 One-horned Indian Rhinoceros 4, 159  
*Onthophagus longicornis* (beetle) 133  
 Oorial see Urial  
*Ophicephalus striatus* (fish) 127  
*opimus*, *Rhombomys* 12, 13, 143, 250, 252, 284, 292, 293, 294  
*Opuntia dillenii* (tree) 257, 268  
*Oreamnus americanus* 195  
*Oreinus richardsoni* (fish) 125  
 Oriental faunal region 4, 26, 40, 50, 58, 104, 133, 152, 256, 267, 271, 273  
*ornata*, *Felis libyca* 138  
 Orr, Robert 147, 149  
*Orthagoceros* subgenus 195  
 Orthopterous insects 17, 19, 110, 290  
*Oryctolagus cuniculus* 209  
*Os penis* or baculum 81, 95, 100, 111, 131, 136, 209, 218, 226, 302, 303  
 Otters 111  
*Otonycteris* genus 42, 79  
*Otorhycteris hemprichii* 63, 68, 79, 80  
 Ounce 6, 153, 156, 170, 194, 199, 203, 232  
*Ovis* genus 203  
*Ovis ammon* 203  
*Ovis ammon polii* 203, 204, 205  
*Ovis ammon cycleros* 203  
*Ovis canadensis* 12, 204  
*Ovis orientalis* 1, 6, 8, 11, 13, 97, 148, 155, 192, 200, 203, 206  
*Ovis orientalis blanfordi* 206, 207  
*Ovis orientalis vignei* 206, 207  
*Ovis orientalis punjabiensis* 206, 207
- Owls  
 Barn Owl 260  
 Collared Pigmy Owl 30, 255  
 Indian Scops Owl 30, 255  
 Little Owl 31, 240, 281, 285  
 Long-eared owl 283  
 Pallid Scops Owl 250, 279, 289  
 Rock Horned Owl 12, 19, 23, 261
- Owls (*cont.*)  
 Scully's Wood Owl 225, 250  
 Spotted Scops Owl 30  
 Spotted Owl 27, 257, 264
- Paguma* genus 129  
*Paguma larvata* 4, 7, 117, 129, 130, 131  
 Pale-footed Weasel 4, 5, 6, 112, 113, 116, 118, 119, 217, 238, 299  
 Pale Grey Shrew 23, 28, 30  
 Pale Hedgehog 8, 15, 16, 20, 21  
 Palearctic zone 1, 4, 30, 32, 41, 64, 67, 100, 247, 252, 259, 275, 304  
 Pallas's Cat 138, 144, 216, 217  
*pallidior*, *Millardia meltada* 255  
 Pallid Scops Owl 250, 279, 289  
*pallipes*, *Canis lupus* 95, 96, 183, 185, 212  
 Palm Civet 4, 7, 117, 129, 130, 131  
 Palm Squirrel 227  
 Pamir Sheep 203, 204, 205  
 Pangolin 4, 8, 91, 92  
*Panthera* genus 153  
*Panthera leo* 4, 155, 156  
*Panthera pardus* 5, 7, 8, 88, 153, 154, 188, 191, 208, 235  
*Panthera tigris* 4, 150, 153, 155, 235  
*Panthera uncia* 6, 153, 156, 170, 194, 199, 203, 232  
*Pantholops hodgsoni* 180  
 Panting 11  
 Para 4, 9, 172, 173  
*Paradoxurinae* subfamily 129  
*Paradoxurus hermaphroditus* 129  
*Paraechinus* genus 15, 20  
*Paraechinus aethiopicus* 20  
*Paraechinus hypomelas* 8, 16, 21  
*Paraechinus hypomelas hypomelas* 21, 22  
*Paraechinus hypomelas blanfordi* 8, 16, 22  
*Paraechinus micropus* 8, 15, 16, 20, 21  
 Paris Museum 314  
 Parasites 18, 36, 38, 40, 66, 151, 162, 216, 231, 232, 260, 312, 322  
 Partridge, Grey 135, 141, 149  
 'Pasang' Wild Goat 189, 200  
*Passer domesticus* 51  
 Pashm 193  
*Paspalum ditichum* (forbe) 9  
*Pavo cristatus* (bird) 148  
 Peacock 148  
 Peanut butter 319  
 Pears (fruit) 37  
*Peganum hormala* (forbe) 293  
 Paignton Zoo 139  
*Peneus indicus* 314  
*pennanti*, *Funambulus* 227  
*Pennisetum dichotomum* (grass) 9  
*Pennisetum orientale* (grass) 8, 198  
*Pennisetum typhoides* (millet) 161, 180, 274  
*Peponocephala* genus 318  
*Peponocephala electra* 318  
 Perineal glands 14, 122, 127  
*Periplaneta* species 27, 140, 228  
 PERISSODACTYLA 159–162  
*Peromyscus* genus 276, 277  
 Persian Gazelle 8, 10, 11, 164, 180, 181  
 Persian House Mouse 263  
 Persian Jird 8, 11, 13, 113, 216, 252, 277, 280, 284, 288  
 Persian Lilac 35, 40, 235  
 Persian Wild Goat or Persian Pasang 4, 8, 9, 97, 155, 164, 181, 188, 189, 200
- Petaurista petaurista* 5, 6, 9, 218, 220, 221, 223, 229  
*Petaurista p. albiwenter* 218  
*Petaurista philippensis* 223  
 Peters, Friedel 158  
 Peters' Horseshoe Bat 4, 52, 54, 55, 56  
*Phaiomys* subgenus 304  
*Phacochoerus aethiopicus* 166  
 Phalai tree 7, 8, 171, 207, 208, 227  
 Pharsi language 196  
*Pheonix dactylifera* (palm) 34, 41, 110, 227  
*Phocaenidae* family 313  
*Phocaena* genus 313  
 PHOLIDOTA 91–94  
*Phragmites communis* (grass) 9, 153  
*Physalia physalia* 228  
*Physeter catodon* 312  
*physalus*, *Balaenoptera* 1, 306, 307, 312  
*Physeteridae* family 312  
*Pica pica* (bird) 222, 249  
*Picea morinda* (tree) 6, 75, 157, 216, 223, 226  
*Picea smithiana* (tree) 6, 75, 157, 216, 223, 226  
 Pigeon 140, 147  
 Pigs, Wild 7, 8, 9, 163, 164  
 Pilleri, George vii, 309, 313, 315, 317  
*Pinus excelsa* (tree) 6, 8, 89, 110, 114, 198, 222, 223, 225, 301  
*Pinus gerardiana* (tree) 8, 86, 87, 197  
*Pinus roxburghii* (tree) 6, 114, 130, 186  
*Pinus wallichiana* (tree) 6, 8, 89, 110, 114, 198, 222, 223, 225, 301  
 Pipal tree 35, 40, 99  
*Pipistrellus* genus 51, 54, 69  
*Pipistrellus babu* 70, 74  
*Pipistrellus ceylonicus* 70, 72  
*Pipistrellus coromandra* 70, 71  
*Pipistrellus dormeri* 70, 74  
*Pipistrellus kuhli* 9, 36, 63, 70, 73  
*Pipistrellus mimus* 70, 71  
*Pipistrellus pipistrellus* 63, 70  
*Pipistrellus tenuis* 73  
 Pir Panjal Markhor 195, 196, 197  
*Pistacia integerrima* (tree) 8, 198  
*Pistacia khinjak* 8  
*Pistacia mutica* 8  
*Pitymys* genus 304  
*Pitymys carruthersi* 304  
*Pitymys juldaschi* 304  
*Pitymys sikimensis* 305  
*Pizonyx vivesi* 36  
*Planipennia* species 82  
*Platanus orientalis* (tree) 82  
*Platanistidae* family 308  
*Platanista* genus 308  
*Platanista indi* 308, 309, 311, 314, 315  
*Platanista gangetica* 308, 309  
*Plecotus* genus 42, 80  
*Plecotus auritus* 81, 82  
*Plecotus austriacus* 4, 6, 9, 80, 81, 82  
*Plecotus puck* 80  
*Plecotus wardi* 80  
*Plectranthus rugosus* (shrub) 6, 8  
 Plumbeous Dolphin 9, 311, 316  
*Poa alpina* (grass) 6, 203  
*Poa pratensis* (grass) 203  
 Polecat, Marbled 4, 8, 112, 118, 120, 121, 244, 250, 279, 292, 295, 297  
*polii*, *Ovis ammon* 203, 204, 205  
*Polygonum affine* (forbe) 6  
 Pomfret (fish) 315  
*Pontoporia* genus 308



- Porcupine 233  
 Porpoises 313  
 Population (human) 1  
*Populus ciliata* (tree) 6, 87  
*Populus euphratica* (tree) 9, 174  
 Potatoes 130, 166, 235, 237, 292, 302  
*Potentilla desertorum* (plant) 6  
 Pouch, cheek 88, 232, 279, 280  
 Pouch, throat 45, 47  
 Pouch, wing 45, 46  
*prateri, Felis chaus* 140  
 Prawns 314, 316  
 Prehensility 237  
*Presbytis* genus 88  
*Presbytis entellus* 6, 85, 86, 88  
*Presbytis entellus ajax* 88, 89  
 Prickly pear 257, 268  
 Priddy, Clyde 87, 128, 224, 302  
 PRIMATES 85–90  
*Primula* (forbe) 6  
*Prionailurus* subgenus 149  
*Prosopis glandulosa* (tree) 291  
*Prosopis spicigera* (tree) 8, 9, 140, 177, 179  
*Prunus armeniaca* (tree) 110, 113, 115, 130  
*Prunus eburnea* (shrub) 8  
 Psammophylic 13, 143, 247, 285  
*Pseudois nayaur* 6, 97, 157, 200, 201, 219  
*Psidium guajava* (tree) 40, 41  
*Psueda fruticosa* (forbe) 244  
 Ptarmigan (bird) 116  
*Pterocles* species 148  
*Pteromys volans* 5  
*Pteropidae* family 32  
*Pteropus* genus 33, 38  
*Pteropus giganteus* 4, 34, 38  
*punjabiensis, Ovis orientalis* 206, 207  
 Pumpkin crop 265  
*Punica granatum* (shrub) 7  
 Punjab University (Lahore, Pakistan) 36, 37, 55, 266, 324  
 Punjab University (Ludhiana, India) 257  
 Pygmy Jerboa 238  
 Pygmy Shrew 6, 23  
 Pygmy Sperm Whale 312  
*Pyrrhocorax graculus* (bird) 194  
*Pyrus aucuparia* (tree) 108  
*Python molurus* 274
- Qadri, H. A. 12  
 Quadripedal 39  
*Quercus balut* (tree) 110, 115, 207  
*Quercus dilatata* 6, 110, 221  
*Quercus ilex* 8, 86, 157, 197, 198, 223, 225, 249, 253  
*Quercus incana* 6  
 Quetta Mole Vole 4, 11, 12, 13, 243, 251, 295, 297, 300  
 Quills, porcupine 233
- Rabbits 209  
 Rabies 260  
 Racer (colubrid) snakes 141  
 Radio-metacarpal pouch 46  
 Ragwort (forbe) 302  
 Raja of Gupis 157  
 Rajasthan (Rajasthan) (India) 4, 16, 17, 44, 51, 79, 95, 99, 103, 104, 133, 135, 139, 140, 141, 148, 154, 177, 179, 211, 258, 275, 282, 283, 287, 290  
 Rana, Mohd (Divisional Forest Officer) 128  
*Rana ridibunda* 141  
*Rana tigrina* 27, 135  
*Rangifer* (reindeer) 166  
 Rangoon 273  
 Ranjha, Dr (Director of Zoological Survey) 161, 312, 317, 318  
 Ranjit Singh, M. K. 198  
*Ranunculaceae* (forbes) 6  
 Rapeseed 185  
 Raptors *see* Birds of prey  
 Raspberry 89  
 Rasse 4, 9, 14, 128, 324  
 Rat 250, 251, 258  
 Rat Snakes 291  
 Ratel 4, 8, 122, 123  
*Rattus* genus 251, 258  
*Rattus exulans* 262  
*Rattus gleadowi* 251, 254, 257  
*Rattus fulvescens* 259  
*Rattus meltada* 255  
*Rattus nitidus* 251, 259, 261  
*Rattus norvegicus* 251, 255, 258, 262, 271  
*Rattus rattoides* 6, 251, 259, 260  
*Rattus rattus* 51, 133, 250, 251, 255, 258, 259, 267, 286  
*Rattus rattus alexandrinus* 251  
*Rattus turkestanicus* 6, 251, 259, 260  
 Ravi River 126, 128, 152, 174, 176, 309  
 Ravine Deer 183  
 Red Bear 4, 6, 11, 106, 107, 299  
 Reddish Pika 8, 11, 213, 214, 215  
 Red Deer 5, 175  
 Red Hunting Dog 106  
 Red Lynx 4, 8, 94, 138, 147, 148, 185, 208  
 Red Sea Bottle-nosed Dolphin 311, 316, 317  
 Red Sea Dolphin 9, 311, 316  
 Reed Cat 4, 8, 9, 12, 14, 138, 140, 212, 255, 257, 274, 276, 288  
 Regent's Park Zoo 108, 131, 144, 145, 160, 172, 183, 203, 204, 250, 270  
 Reindeer 166  
*Reptonia buxifolia* (shrub) 8  
 Rhesus Monkey 6, 85, 86, 155  
 Rheumatism, cure for 39, 312  
*Rheum emodi* (wild rhubarb) 8, 299  
*Rhinoceros unicornis* 4, 159  
*Rhinocerotidae* family 159  
*Rhinolophidae* family 41, 51, 52, 56, 63, 82  
*Rhinolophus* genus 42, 52  
*Rhinolophus blasii* 4, 52, 54, 55, 56  
*Rhinolophus ferrumequinum* 4, 8, 9, 54, 59  
*Rhinolophus hipposideros* 52, 54, 55  
*Rhinopomatidae* family 43, 61  
*Rhinopoma* genus 10, 41  
*Rhinopoma hardwickei* 4, 43, 44  
*Rhinopoma kinneari* 43  
*Rhinopoma microphyllum* 8, 10, 35, 36, 42, 43, 51  
*Rhinopoma sumatrae* 44  
*Rhododendron anthopogon* (shrub) 6  
*Rhombomys* genus 252  
*Rhombomys opimus* 12, 13, 143, 250, 252, 284, 292, 293, 294  
 Rib-faced Deer 4, 7, 170, 171, 187  
*Ribena* species (wild currants) 169  
*Ribes emodense* 169, 194  
 Rice crops *see* *Bandicota bengalensis* and *Millardia meltada*  
 Rinderpest 199, 207  
 Riverain tract 9, 152, 173, 210  
 Rizvi, Dr 154, 190  
 Roberts, Guy 91  
 Robertson, Trevor vii, 98, 137, 309  
 Rock-horned Owl 12, 19, 23, 261  
 Rock Python 274  
 Rocky Mountain Goat 195  
 RODENTIA 218–305  
 Roof Rat 51, 133, 250, 251, 255, 258, 259, 267, 286  
 Rorqual 1, 306, 307, 312  
*Rosa webbiana* (shrub) 8, 110, 249  
 Rose hips 103, 249  
*Rousettus* genus 32, 33  
*Rousettus aegyptiacus* 4, 33, 35, 36, 46  
*Rousettus arabicus* 33  
*Rousettus leschenaulti* 33, 36, 40, 79  
 Royal Scottish Museum 28, 158  
*roylei, Alticola* 6, 11, 13, 118, 217, 243, 252, 298, 300, 303  
*roylei, Ochotona* 5, 6, 8, 118, 120, 209, 213, 216, 280, 298  
 Royle's High Mountain Vole 6, 11, 13, 118, 217, 243, 252, 298, 300, 303  
 Royle's Pika 5, 6, 8, 118, 120, 209, 213, 216, 280, 298  
*Rubus purpureus* (shrub) 89  
*Rucervus* subgenus 175  
*rufescens, Ochotona* 8, 11, 213, 214, 215  
*rufescens, Rattus rattus* 259  
*Ruminantia* suborder 166, 187  
*rupicapra, Rupicapra* 6  
 Russian Crested Porcupine 233  
 Russian Olive 23, 106, 110, 113, 137
- Saccharum munja* (grass) 155, 164, 173, 210  
*Saccharum spontaneum* 9, 152, 164, 173  
 Saiga 180  
*Salix himalayensis* (shrub) 169, 194  
*Salmalia malabarica* (tree) 7, 34, 37, 172  
*Salpingotus* genus 238  
*Salpingotus crassicaudata* 239  
*Salpingotus michaelis* 10, 11, 13, 236, 238, 239  
*Salpingotus thomasi* 239  
*Salsola foetida* (forbe) 9, 274, 295  
*Salsolium nedulosae* (forbe) 244  
 Salt intake 12, 36, 258, 283  
 Saltatorial 236, 238, 240, 244, 281  
 Saltwort 258  
*Salvadora oleoides* (tree) 8, 191  
*Salvadora persica* (tree) 8, 228  
 Sambar Deer 173  
*Sambucus ebulus* (shrub) 6, 303  
 Sand Boas 13, 14, 143, 240, 244, 247  
 Sand Cat 4, 10, 13, 14, 138, 142, 240, 244  
 Sand Coloured Rat 251, 254, 257  
 Sand-dunes 9, 105, 143, 234, 239, 246, 264, 282, 283, 285, 289, 294  
 Sand Fox 4, 10, 13, 100, 101, 104, 247  
 Sandgrouse 148  
 Sandpiper (bird) 153  
 Sand Rats 281, 288  
 Sand Viper 12, 240, 244, 247, 285  
 Sapodil (plum tree) 40, 41  
 Sarmanier 4, 8, 112, 118, 120, 121, 244, 250, 279, 292, 295, 297  
 Savage, Christopher vii, 140, 174  
 Savannah 6, 89, 179  
 Saw-scaled Viper 12, 13, 258, 271, 283  
*saxicola, Mus* 266  
*saxicola, Panthera pardus* 153

- Saxifraga sibirica* (forbe) 6  
*Scarabaeidae* 67, 99  
 Schaller, George B. vii, 12, 103, 111, 115, 136, 154, 156, 157, 158, 190, 191, 194, 198, 200, 203, 205, 207, 208, 230, 270, 271, 305  
*Schistocerca gregaria* (locust) 23, 293  
*Schizodactylus montrosus* (insect) 51  
 Schreiber's Bat 42, 50, 83  
*Schreibersi, Miniopterus* 42, 50, 83  
*Scilla species* 292  
*Scilla hohinackeri* (plant) 297  
*Scirpus maritimus* (sedge) 274  
*Scirpus subulatus* 274  
*Sciuridae* family 218  
*Sclerophyllus forest* 4, 5  
 Scorpions 16, 19, 29, 103, 104, 133, 135  
*Scoteinus pallidus* 66, 68, 76  
*Scotophilus* genus 42, 76  
*Scotophilus heathi* 9, 11, 67, 68, 77, 78  
*Scotophilus kuhli* 76  
*Scotophilus temminckii* 77  
*Scotophilus wroughtoni* 77  
*Scotozous dormeri* 70, 74  
 Scrub typhus 260, 263  
 Seistan 19, 60, 243, 293, 294  
*Skimmia laureola* (shrub) 6  
 Sella 52, 55, 59  
*Selenarctos thibetanus* 5, 6, 8, 11, 106, 107, 109, 230  
*Selenarctos thibetanus langiger* 108  
*Selenarctos t. gedrosianus* 8, 108, 109  
*Selysius* subgenus 64  
*Senecio chrysanthemoides* (forbe) 302  
*Sepia species* (squids) 314  
 Serval Cat 145  
 Setzer, Henry W. vii  
 Sewer Rat 251, 255, 258, 262, 271  
 Shah, Anis Haider 176  
 Shah Khan, Wing Commander 107, 201, 202  
 Shalimar Gardens 51, 56  
 Shapu 206, 207  
 Sharif, Mian 49  
 Sharks 309, 315  
 Sheath-tailed Bats 45  
 Sheikh ur-Rahman (Col.) 148, 149  
 Sheikh Wali Mohammed vii  
 Shooting 319, 322  
*Shorea robusta* (tree) 7  
 Short-nosed Fruit Bat 40  
 Short-tailed Mole Rat 9, 12, 141, 251, 272, 274, 275, 296, 300  
 Shrews  
   Anderson's Shrew 23, 25, 28  
   Etruscan Shrew 1, 4, 23, 24, 25, 27  
   Grey Shrew 23, 28, 30, 31  
   House Shrew 4, 23, 25, 264  
   Lesser Shrew 6, 23  
   Musk Shrew 25  
   Pale Grey Shrew 30  
   Pygmy Shrew 23  
   Sari's Pygmy Shrew 27  
   White-toothed Shrew 29  
 Shrimps 314  
*Sibbaldus musculus* 306  
 Siberian Ibex 6, 188, 192  
 Sibi Plain 22, 71, 122, 210  
*sibirica, Capra ibex* 6, 188, 192  
 Sibling species 80  
*Sicista* genus 236  
*Sicista concolor* 6, 236, 237, 243, 251, 253  
*Sicista tianschanica* 236  
*Sicistinae* subfamily 236  
 Siddiqui Sifatullah (Director, Zoological Survey of Pakistan) vii, 2, 306  
 Sikkim Vole 305  
 Silk cotton tree 7, 34, 37, 172  
 Silver fir tree 114, 225, 230  
 Silver Mountain Vole 298, 299  
 Simla (India) 65, 204  
 Simon, Noel 205  
 Sind Bat 35, 65, 66, 76  
*sindensis, Suncus murinus* 25  
*sindica, Panthera pardus* 153  
 Sind Ibex 189  
 Sind Rice Rat 4, 9, 165, 251, 257, 262, 271, 272, 274  
 Sirin tree 40, 227  
*Sisymbrium sophia* (forbe) 232  
 Slender-billed Gull 314  
 Skink 19  
 Skinning 320  
 Small Five-toed Jerboa 12, 13, 236, 241, 242, 243, 247  
 Small Indian Civet 4, 9, 14, 128, 324  
 Small Kashmir Flying Squirrel 223  
*Sminthus leathemi* 6, 236, 237, 243, 251, 253  
 Smithsonian Museum 28, 29, 69, 119, 237, 246, 248, 253, 298, 299, 301, 302, 312, 324  
 Smooth-coated Otter 4, 9, 124, 125, 126, 310  
 Snakes  
   Cobra 123, 135, 141, 260, 274, 288  
   Coluber (Racers) 141  
   Diadem Rat Snake 258, 279, 285, 288, 291  
   Euphratic Viper 271, 279  
   Keelback 27, 274  
   Python 274  
   Racers (*Colubridae*) 141  
   Rat Snake 291  
   Sand Boas 13, 14, 143, 240, 244, 247, 276, 283, 285  
   Sand Viper 12, 240, 244, 247, 285  
   Saw-scaled Viper 12, 13, 258, 271, 283  
 Snow Bear 107  
 Snow Cock 147, 157  
 Snow Leopard 6, 153, 156, 170, 194, 199, 203, 232  
 Snow Pigeons 147  
 Snow Vole 302  
 Soay Sheep 208  
 Soft-furred Field Rat 251, 255  
 Sokolov, Ivan vii, 120, 217, 220  
*Solanacea melongena* (eggplant) 274  
 Solifugid spiders 133  
 Somali Wild Ass 161  
 Sonar (natural) 23, 32, 55, 60, 70, 310  
*Sophora mollis* (bush) 8  
*Sorbaria tomentosa* (shrub) 6  
*Sorbus aucuparia* (shrub) 6  
*Sorex* genus 23  
*Sorex minutus* 6, 23  
*Sorghum sudanense* (cereal) 110, 180, 185, 257  
*Soricidae* family 15, 23  
*Sotalia* genus 315  
*Sotalia lentiginosa* 315, 317  
*Sotalia plumbea* 311, 314, 315, 316  
*Sousa* genus 315  
*Sousa lentiginosa* 315, 317  
*Sousa plumbea* 9, 311, 316  
*Spalerosophis diadema* 258, 279, 285, 288, 291  
 Sparrow Hawk 228  
 Sparrow, House 51  
 Speed in running 13  
 Sperm Whale 312  
 Spider 12, 55  
 Spiny Mouse 4, 8, 10, 251, 262, 266, 269, 270  
 Spiracle 306, 309  
 Spouting (whales) 307  
 Spruce tree 6, 75, 157, 216, 223, 226  
 Squids 314  
 Squirrels 218  
   Five Striped Squirrel 227  
   Giant Red Squirrel 218  
   Northern Palm Squirrel 227  
   Small Kashmir Squirrel 223  
   Woolly Flying Squirrel 225  
 Srinagar (Kashmir) 110  
 Stag (Kashmir Stag) 5, 175  
 Stanley Zoo (Northern Ireland) 177  
 Steppe Cat 138, 144, 216, 217  
 Steppe forest 8, 207, 212, 214, 226, 234  
 Steppe mountain zone 67, 105, 109, 112, 136, 197, 207, 212, 214, 232, 232, 260, 277, 280, 294, 296, 305  
*Sterculia villosa* (tree) 7  
 Sterndale, Robert 1  
*Stipa pennata* (grass) 8  
*Stirlingi, Marmota caudata* 228  
 Stoat 4, 6, 112, 116, 117, 118, 217, 238, 299  
 Stone marten 4, 8, 111, 112, 113, 118, 121, 170, 216, 217, 238, 250, 261, 279, 281, 289  
*stoliczkanus, Alticola* 252, 298, 299  
*stoliczkanus, Suncus* 23, 25, 28  
 Stoliczka's High Mountain Vole 252, 298, 299  
 Stoliczka's Shrew 23, 25, 28  
 Storage of food 118, 121, 215, 217, 248, 250, 255, 273, 276, 278, 289, 290, 293, 295, 297  
 Strawberries (wild) 87  
 Strelkov, P. 67  
 Street Expedition 30, 62, 139, 158, 181, 183, 294  
*Streptopelia senegalensis* (bird) 228  
 Striped Hyaena 8, 96, 135, 136, 183, 191, 236  
 Strobl, H. 28  
*Suaeda fruticosa* (forbe) 8  
 Sub-alpine scrub zone 6, 107, 116, 169, 230, 237, 253, 303  
 Suborbital glands 14, 175, 177, 180, 182, 185, 200  
 Subtropical Thorn Forest 8, 93, 110  
*subgutturosa, Gazella* 8, 10, 11, 164, 180, 181  
 Suckling 17, 234, 307  
 Sugar-cane 99, 166, 177, 235  
 Sulphur-bottomed Whale 307  
 Suez Canal 315  
*Suidae* family 163  
*Suncus* genus 23, 25  
*Suncus etruscus* 1, 4, 23, 24, 25, 27  
*Suncus malayanus* 28  
*Suncus murinus* 4, 23, 25, 264  
*Suncus stoliczkanus* 23, 25, 28  
 Sundevall's Jird 8, 252, 288, 292  
 Supra foetation 211  
 Surra (disease) 162  
*Sus* genus 163  
*Sus scrofa* 7, 8, 9, 163, 164  
 Susliks 218  
 Sutlej River 152, 174, 194, 309  
 Swallows 62  
 Swamp Cat 4, 8, 9, 12, 14, 138, 140, 212, 255, 257, 274, 276, 288, 291  
 Swamp Deer 4, 175  
 Sweat glands 12



- Sweet Potatoes 235, 265, 287  
 Swinhoe's Jird 8, 252, 288, 292  
*Syconycteria australis* 41  
 Syed Asad Ali vii, 189, 207  
 Syed Babar Ali (International Trustee, World Wildlife Fund) vii  
*sylvaticus*, *Apodemus* 4, 6, 8, 14, 151, 237, 251, 252, 253, 254, 268, 280, 302, 303  
 Symbiosis 195, 314  
 Sympatry 20, 118, 141, 199, 202, 220, 223, 237, 253, 255, 257, 258, 277, 280, 303
- Taber, Richard W. vii, 28, 265, 276  
*Tadarida* genus 41, 60, 61  
*Tadarida aegyptiaca* 4, 35, 60, 61  
*Tadarida teniotis* 61  
 Tadzikhistan 55, 67, 83, 217, 254, 298  
 Tahr 188  
 Taiga (biome) 5  
 Taiwan 58, 77, 83, 221  
 Talpur, Mir Ali Murad, Mir of Khairpur 152, 179  
*Tamarix* (bushes) 113, 152, 293  
*Tamarix aphylla* (tree) 8, 9, 283  
*Tamarix articulata* (tree) 9  
*Tamarix dioica* 9, 155, 173, 174  
 Tapeworms 216  
*Taphozous* genus 10, 41, 45  
*Taphozous kachhensis* 35, 36, 45, 47, 50  
*Taphozous nudiventris* 47  
*Taphozous perforatus* 45, 46  
*Taphozous saccolaimus* 45, 47  
*Tatera* genus 285  
*Tatera indica* 12, 103, 104, 252, 281, 282, 285, 286, 289, 291, 322  
*Tatera afra* 288  
 Taurus Mountains (Turkey) 189, 190  
 Tawny Eagle 152  
*Taxus baccata* (tree) 6, 87, 89  
*Tecomella undulata* (tree) 8  
 Temminck's House Bat 76  
 Temminck's Cat 145  
*temminckii*, *Scotophilus* 77  
 Tenebrionid (beetles) 31  
*Terratoscincus* (sand ghekos) 143  
 Termites 16, 93, 103  
*Testuda horsfieldi* 18, 137  
*Tetrapogon villosa* (Grass) 208  
*Tetraogallus himalayensis* (bird) 147, 157  
*Tettigonia* species 55  
 Texas 179  
 Thal Desert 102, 103, 139, 141, 282, 283, 285  
 Thar Desert 7, 9, 16, 177, 184, 185, 285  
*Themeda anathera* (grass) 7, 187  
*thibetanus*, *Selenarctos* 5, 6, 8, 11, 106, 107, 109, 230  
*thinobius*, *Eremaelurus* 4, 10, 13, 14, 138, 142, 240, 244  
*Thymus serpyllum* (shrub) 8  
 Tian Shan Mountains 65, 108, 146, 157, 193, 194, 203, 205, 237, 298  
*tianschanica*, *Sicista* 236  
 Tibetan Antelope 180  
 Tibetan Argali 203  
*tibetanus*, *Lepus capensis* 212  
 Ticks (ectoparasites) 38, 40  
 Tiger 4, 150, 153, 155, 235  
 Tigris River 126, 133  
*tigris*, *Panthera* 4, 150, 153, 155, 235  
*Tipulidae* (larvae) 99  
 Toads 17
- Toadstools 110, 255  
 Tomatoes 130, 292  
 Tomb Bat 45, 46  
 Tongue 91, 93, 172, 192, 194  
 Toothed Whales 306, 308, 310  
 Torpidity 21, 39, 44, 48, 58, 72, 79, 240, 247, 289, 291, 292  
 Tortoise 18, 137  
*Trachelocele* subgenus 181  
*tragocamelus*, *Boselaphus* 4, 6, 7, 14, 175, 176  
 Traps 319, 320  
 Tree Sloth 122  
*trevelyani*, *Felis bengalensis* 149  
*Trichinosis* (disease) 260  
*tridens*, *Asellia* 4, 8, 36, 53, 57, 59  
 Trident Leaf-nosed Bat 4, 8, 36, 53, 57, 59  
 Tropical deciduous forest 7, 115, 171  
 Tropical dry pine forest 186, 221  
 Tropical thorn forest 176, 282, 289  
 Trout 125  
 Trout, Snow 125  
 True's Vole 302  
 Tube-nosed Bat 42, 83  
 Tubercles 313  
*Tulipa* species 8, 213, 292  
*Tulipa chrysantha* (plant) 297  
 Tuna (fish) 315  
 Tundra biome 5, 118, 146  
*Turdoides earlei* (bird) 142  
 Turkestan region 67, 69, 70, 75, 106, 137, 243, 254, 275, 293, 296, 305  
 Turkestan Rat 6, 251, 259, 260  
*turkestanicus*, *Rattus* 6, 251, 259, 260  
*Tursiops* genus 316  
*Tursiops aduncus* 311, 316, 317  
*Tursiops truncatus* 316, 317  
 Tusks 164, 167, 171  
 Typhus 260, 263  
*Typha augustata* (reed) 9  
*Typha elephantina* (reed) 9  
 Tympanic bullae 13, 238, 281, 288  
*tyleri*, *Suncus murinus* 25
- Uca* species 274  
*uncia*, *Panthera* 6, 153, 156, 170, 194, 199, 203, 232  
 Ungulates 1  
*unicornis*, *Rhinoceros* 4, 159  
 University of Punjab (Lahore, Pakistan) 36, 37, 55, 266, 324  
 University of Punjab (Ludhiana, India) 257  
 University of Maryland 2, 24, 26, 28, 55, 70, 75, 76, 77, 82, 139, 217, 220, 238, 245, 246, 249, 259, 273, 275, 277, 285, 296, 302, 303  
 Urial 1  
 Urine 12, 192, 199, 206, 216  
*Uromastix* (lizards) 17, 21  
*Uromastix hardwickei* 140, 141  
*Ursidae* family 106  
*Ursus* genus 106  
*Ursus arctos* 4, 6, 11, 106, 107, 299  
 Uruguay 308  
 Uttar Pradesh (India) 51, 148, 177  
 Uzbekistan (USSR) 67, 106, 203, 230
- Vampire, False 49
- Varanus* species (Lizards) 135, 240  
*Varanus griseus* 228  
 Velvet Mites 29  
*Vespertilionidae* family 51, 54, 63  
*Vespertilio pellucens* 35, 65, 66, 76  
 Vetches 161  
*Viburnum* (Ill-scented) 6, 87, 89, 103, 115  
*vignei*, *Ovis orientalis* 206, 207  
*villosa*, *Macaca mulatta* 85  
*Viola* (Wild Violet) 6  
 Vipers *see under* Snakes  
*Vipera lebetina* 271, 279  
*Viverricula* genus 127  
*Viverricula indica* 4, 9, 14, 128, 324  
*Viverridae* family 127  
*viverrina*, *Felis* 4, 9, 138, 150, 151  
 Voles  
   Carruthers' Vole 304  
   High Altitude Voles 108, 120, 147, 252, 297, 304  
   Mole Voles 295, 302  
   Murree Vole 302  
   Silver Vole 298, 299  
   True's Vole 302  
 Voles 13, 243, 250, 295  
*Vormela* genus 120  
*Vormela peregusna* 4, 8, 112, 118, 120, 121, 244, 250, 279, 292, 295, 297  
*Vulpes* genus 12, 100, 257  
*Vulpes bengalensis* 8, 18, 100, 101, 103, 104, 274  
*Vulpes cana* 100, 101, 105, 244, 247, 285  
*Vulpes fulva* 103  
*Vulpes rüppelli* 4, 10, 13, 100, 104, 247  
*Vulpes vulpes* 8, 100, 101, 285  
*Vulpes vulpes griffithi* 8, 19, 100, 101, 102, 213, 281, 289, 295, 297  
*Vulpes vulpes montana* 10, 100, 102  
*Vulpes vulpes pusilla* 96, 100, 212, 285, 291
- Wagner's Gerbil 281  
*Wallagonia atto* (fish) 310  
 Watson, H. E. 270  
 Waite, H. W. vii, 103, 136, 137, 148, 208, 283  
 Walnut tree 221, 222, 225, 261  
 Walton, Daniel vii, 34, 62, 68, 71, 77  
 Walton, Mrs Gloria 100  
*wardi*, *Apodemus flavicollis* 255  
 Warthogs 166  
 Wasps 135  
 Waziristan 8, 22, 106, 108, 110, 120, 147, 150, 154, 161, 198, 207, 258, 280, 293  
 Weasel 4, 5, 6, 112, 113, 116, 118, 119, 217, 238, 299  
 Whale bone 306  
 Whales  
   Fin Whale 306  
   Great Blue Whale 307  
   Humpback Whale 308  
   Pygmy Sperm Whale 312  
   Sperm Whale 312  
 Wheat 166, 215, 291, 292, 296  
 Wheeler, Mrs V. 184  
 Whiskered Bat 6, 63, 64, 68  
 White-cheeked Marten 4, 6, 7, 111, 112, 113, 114, 221, 225, 255, 264  
 White Eye (bird) 228  
 White-eyed Buzzard 291  
 White-footed Weasel 4, 5, 6, 112, 113,

- 116, 118, 119, 217, 238, 299  
 Whitehead, T. (Capt.) 106, 116, 145, 249, 250, 269, 299  
 White-toothed Shrew 4, 23, 24, 29  
 Wild Ass 159, 160  
 Wild Dog (Indian) 106  
 Wild Pig 7, 8, 9, 163, 164  
 Williams' Jerboa 236, 241, 242, 245  
*williamsi*, *Allactaga* 236, 241, 242, 245  
 Willow 169, 194  
 Winkler, Claus 199  
*Withania coagulans* (shrub) 8  
 Wolf 8, 95, 162, 177, 180, 208, 236  
 Wood-Anderson, Jeremy *see* Anderson, J. A. W.  
 Woodchuck 231  
*Woodfordia fruticosa* (shrub) 7  
 Woodlice 25, 30  
 Woodmouse 4, 6, 8, 14, 151, 237, 251, 252, 253, 254, 268, 280, 302, 303  
 Woodpecker 84  
 Wood Sandpiper 153  
 Woolly Flying Squirrel 221, 225  
 Wormwood 8, 112, 198, 212, 231, 237, 247, 280  
 Wrinkled-lipped Bat 4, 35, 60, 61  
 Wrist spur 219, 221, 223  
*wroughtoni*, *Scotophilus* 77  
*wynnei*, *Hyperacrius* 302  
 Wynne's Vole 302  
 Yahya, Arbab (Forest Ranger) 141, 145, 190, 247  
 Yam 235, 265, 287  
 Yellow-bellied Bat 9, 11, 67, 68, 77, 78  
 Yellow-bellied Weasel 118  
 Yellow Desert Bat 66, 68, 76  
 Yellow-necked Field Mouse 252, 253, 255  
 Yellow-throated Marten 4, 6, 7, 111, 112, 113, 114, 221, 225, 255, 264  
 Yellow-throated Shrew 23, 25, 28  
 Yew tree 6, 87, 89  
  
*Zamensis mucosus* 291  
*Zapodidae* family 236  
*zarudnyi*, *Meriones crassus* 292  
*Zizyphus* (shrub) 21, 51, 99, 166, 228  
*Zizyphus jujuba* (tree) 123, 129, 174  
*Zizyphus mauritiana* (shrub) 7, 103, 171, 172  
*Zizyphus nummularia* 8, 110, 191  
 Zoos  
     Bahawalpur 88, 96, 100, 123, 148, 149, 178  
     Zoos (*cont.*)  
         Calcutta 166, 223  
         Chicago 90  
         Clifton 247  
         Detroit 105  
         Dublin 149  
         Duncan (Vancouver I., BC) 39  
         East Berlin 151  
         Frankfurt 152, 258  
         Hamburg 190  
         Jaipur 98, 127  
         Kabul 145  
         Karachi 174  
         Lahore 94, 95, 98, 108, 110, 111, 123, 126, 133, 137, 139, 154, 161, 170, 173, 174, 177, 180, 185  
         Oklahoma 94  
         Paignton 139  
         Prague 188  
         Regents' Park 108, 131, 144, 145, 160, 172, 183, 203, 204, 250, 270  
         Stanley Zoo 177  
     Zoogeographical regions 4  
     Zoological Institute of Leningrad 305  
     Zoological Survey of Pakistan 40, 46, 57, 261, 265, 306, 308, 317, 318, 324  
     *Zosterops palpebrosa* (bird) 228  
     Zulfiqar Ali Shah 173















